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**sherpa**  
*Release 1.3*

**sherpa development team**

**Jun 19, 2024**



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CHAPTER  
**ONE**

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## INTRODUCTION

`sherpa` is the deployment framework of the Next-gen Kaldi project.

`sherpa` does only one thing, using a pre-trained model to transcribe speech. If you are interested in how to train your own model or fine tune a pre-trained model, please refer to `icefall`.

At present, `sherpa` has the following sub-projects:

- `k2-fsa/sherpa`
- `k2-fsa/sherpa-onnx`
- `k2-fsa/sherpa-ncnn`

The differences are compared below:

	k2-fsa/sherpa	k2-fsa/sherpa-onné	k2-fsa/sherpa-ncnn
Installation difficulty	<b>hard</b>	<b>easy</b>	<b>easy</b>
NN lib	PyTorch	onnéruntime	ncnn
CPU Support	x86, x86_64	x86, x86_64, arm32, arm64	x86, x86_64, arm32, arm64, **RISC-V**
GPU Support	Yes (with CUDA for NVIDIA GPUs)	Yes	Yes (with Vulkan for ARM GPUs)
OS Support	Linux, Windows, macOS	Linux, Windows, macOS, iOS, Android	Linux, Windows, macOS, iOS, Android
Support batch_size > 1	Yes	Yes	No
Provided APIs	C++, Python	C, C++, Python, C#, Java, Kotlin, Swift	C, C++, Python, C#, Kotlin, Swift
Model types	streaming, non-streaming	streaming, non-streaming	streaming only

We also support [Triton](#). Please see [Triton](#).

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CHAPTER  
**TWO**

---

**DOWNLOAD PDF**

We provide a single pdf file containing all the documentation.

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**Hint:** All Chinese related content is not included in the pdf file.

---

Please download it from the following address:

<https://k2-fsa.github.io/sherpa/sherpa.pdf>

---

**Note:** For Chinese users, you can use the following mirror:

<https://hub.nuua.cf/k2-fsa/sherpa/releases/download/doc/sherpa.pdf>

---

Please always download the latest version.

The pdf file is updated automagically whenever the doc is changed.



## **SOCIAL GROUPS**

### **3.1 WeChat**

If you have a [WeChat](#) account, you can scan the following QR code to join the WeChat group of next-gen Kaldi to get help.



### **3.2 QQ**

The QQ group is also given below:



---

**Hint:** The QQ group number is 744602236.

---

### 3.3 Bilibili (B )

Please visit <https://search.bilibili.com/all?keyword=%E6%96%B0%E4%B8%80%E4%BB%A3Kaldi> for various demo videos of Next-gen Kaldi.

### 3.4 YouTube

To get the latest news of next-gen Kaldi, please subscribe the following YouTube channel by Nadira Povey:

[https://www.youtube.com/channel/UC\\_VaumpkmINz1pNkFXAN9mw](https://www.youtube.com/channel/UC_VaumpkmINz1pNkFXAN9mw)

## RUN NEXT-GEN KALDI IN YOUR BROWSER

This page describes how to try Next-gen Kaldi in your browser.

---

**Hint:** You don't need to download or install anything. All you need is a browser.

---

The server is running on CPU within a docker container provided by [Huggingface](#) and you use a browser to interact with it. The browser can be run on Windows, macOS, Linux, or even on your phone or iPad.

You can upload a file for recognition, record your speech via a microphone from within the browser and submit it for recognition, or even provider an URL to an audio file for speech recognition.

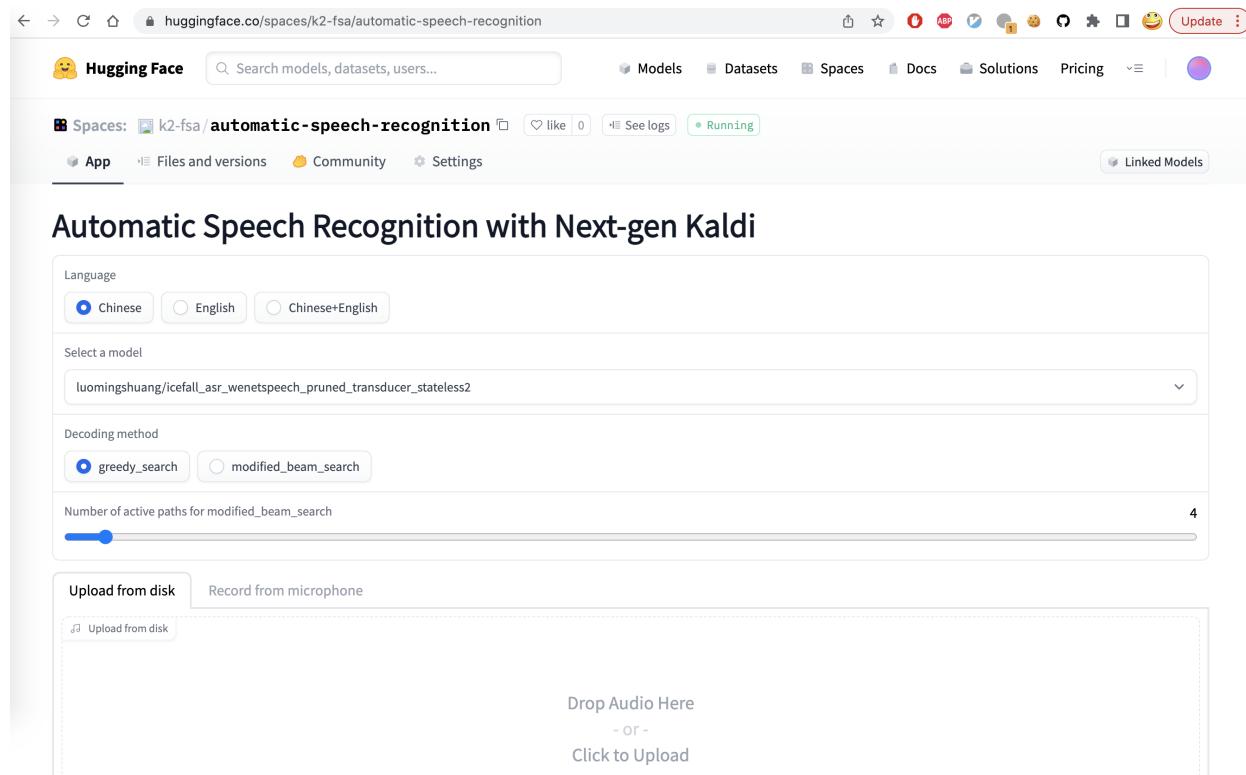
Now let's get started.

### 4.1 Visit our Huggingface space

Start your browser and visit the following address:

<https://huggingface.co/spaces/k2-fsa/automatic-speech-recognition>

and you will see a page like the following screenshot:



**Hint:** If you don't have access to Huggingface, please visit the following mirror:

<https://hf-mirror.com/spaces/k2-fsa/automatic-speech-recognition>

---

You can:

1. Select a language for recognition. Currently, we provide pre-trained models from `icefall` for the following languages: `Chinese`, `English`, and `Chinese+English`.
2. After selecting the target language, you can select a pre-trained model corresponding to the language.
3. Select the decoding method. Currently, it provides `greedy_search` and `modified_beam_search`.
4. If you selected `modified_beam_search`, you can choose the number of active paths during the search.
5. Either upload a file or record your speech for recognition.
6. Click the button `Submit for recognition`.
7. Wait for a moment and you will get the recognition results.

The following screenshot shows an example when selecting `Chinese+English`:

Automatic Speech Recognition with Next-gen Kaldi

Language  
 Chinese  English  Chinese+English

Select a model  
luomingshuang/icefall\_asr\_tal-csasr\_pruned\_transducer\_stateless5

Decoding method  
 greedy\_search  modified\_beam\_search

Number of active paths for modified\_beam\_search  
4

Upload from disk Record from microphone

Record from microphone  
0:04 / 0:04

Submit for recognition

Recognized speech from recordings  
这个是频繁的啊不认识记下来 FREQUENTLY 频繁地

Wave duration : 4.690 s  
Processing time: 0.867 s  
RTF: 0.867 / 4.690 = 0.185

In the bottom part of the page, you can find a table of examples. You can click one of them and then click **Submit for recognition**.

huggingface.co/spaces/k2-fsa/automatic-speech-recognition

Upload from disk

Drop Audio Here  
- or -  
Click to Upload

Submit for recognition

Recognized speech from uploaded file

Examples

Language	Select a model	Decoding method	Number of active paths for modified_beam_search	Upload from disk
English	csukuangfj/icefall-asr-librispeech-pruned-transducer-stateless3-2022-05-13	greedy_search	4	./test_wavs/librispeech/1089-134686-0001.wav
English	csukuangfj/icefall-asr-librispeech-pruned-transducer-stateless3-2022-05-13	greedy_search	4	./test_wavs/librispeech/1221-135766-0001.wav
English	csukuangfj/icefall-asr-librispeech-pruned-transducer-stateless3-2022-05-13	greedy_search	4	./test_wavs/librispeech/1221-135766-0002.wav
English	wgb14/icefall-asr-gigaspeech-pruned-transducer-stateless2	greedy_search	4	./test_wavs/gigaspeech/1-minute-audiobook.opus
English	wgb14/icefall-asr-gigaspeech-pruned-transducer-stateless2	greedy_search	4	./test_wavs/gigaspeech/100-seconds-podcast.opus
English	wgb14/icefall-asr-gigaspeech-pruned-transducer-stateless2	greedy_search	4	./test_wavs/gigaspeech/100-seconds-...

## 4.2 YouTube Video

We provide the following YouTube video demonstrating how to use <https://huggingface.co/spaces/k2-fsa/automatic-speech-recognition>.

---

**Note:** To get the latest news of [next-gen Kaldi](#), please subscribe the following YouTube channel by Nadira Povey:

[https://www.youtube.com/channel/UC\\_VaumpkmINz1pNkFXAN9mw](https://www.youtube.com/channel/UC_VaumpkmINz1pNkFXAN9mw)

---

<https://youtu.be/E1N3r9dkKE4>

## 4.3 Other Huggingface spaces

- ASR + WebAssembly + sherpa-ncnn: Please see [Huggingface Spaces \(WebAssembly\)](#)
- TTS: Please see: <https://huggingface.co/spaces/k2-fsa/text-to-speech>

## PRE-TRAINED MODELS

### 5.1 Pre-trained models for different projects

Project	Pretrained models
k2-fsa/sherpa	<a href="#">Click here</a>
k2-fsa/sherpa-onnx	<a href="#">Click here</a>
k2-fsa/sherpa-ncnn	<a href="#">Click here</a>

### 5.2 How to download

We are hosting our pre-trained models on [Huggingface](#) as git repositories managed by [Git LFS](#).

There are at least two methods for downloading:

- Using `git lfs`
- Using `wget`

In the following, we use the pre-trained model [pkufool/icefall-asr-zipformer-streaming-wenetspeech-20230615 \(Chinese\)](#) as an example.

#### 5.2.1 Using git lfs

Please first install `git-lfs` by following <https://git-lfs.com/>.

Linux

macOS

Windows

```
# apt/deb
sudo apt-get install git-lfs

# yum/rpm
sudo yum install git-lfs
```

Please see <https://github.com/git-lfs/git-lfs/blob/main/INSTALLING.md> for details.

```
brew install git-lfs
```

Please visit <https://gitforwindows.org/> to download and install git-lfs.

Then use the following commands to download pre-trained models:

Linux/macOS

Windows (Powershell)

Windows (cmd)

```
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/pkufool/icefall-asr-zipformer-
˓→streaming-wenetspeech-20230615
cd icefall-asr-zipformer-streaming-wenetspeech-20230615
git lfs pull --include "exp/*chunk-16-left-128.*onnx"
```

```
$env:GIT_LFS_SKIP_SMUDGE="1"
git clone https://huggingface.co/pkufool/icefall-asr-zipformer-streaming-wenetspeech-
˓→20230615
cd icefall-asr-zipformer-streaming-wenetspeech-20230615
git lfs pull --include "exp/*chunk-16-left-128.*onnx"
```

```
set GIT_LFS_SKIP_SMUDGE="1"
git clone https://huggingface.co/pkufool/icefall-asr-zipformer-streaming-wenetspeech-
˓→20230615
cd icefall-asr-zipformer-streaming-wenetspeech-20230615
git lfs pull --include "exp/*chunk-16-left-128.*onnx"
```

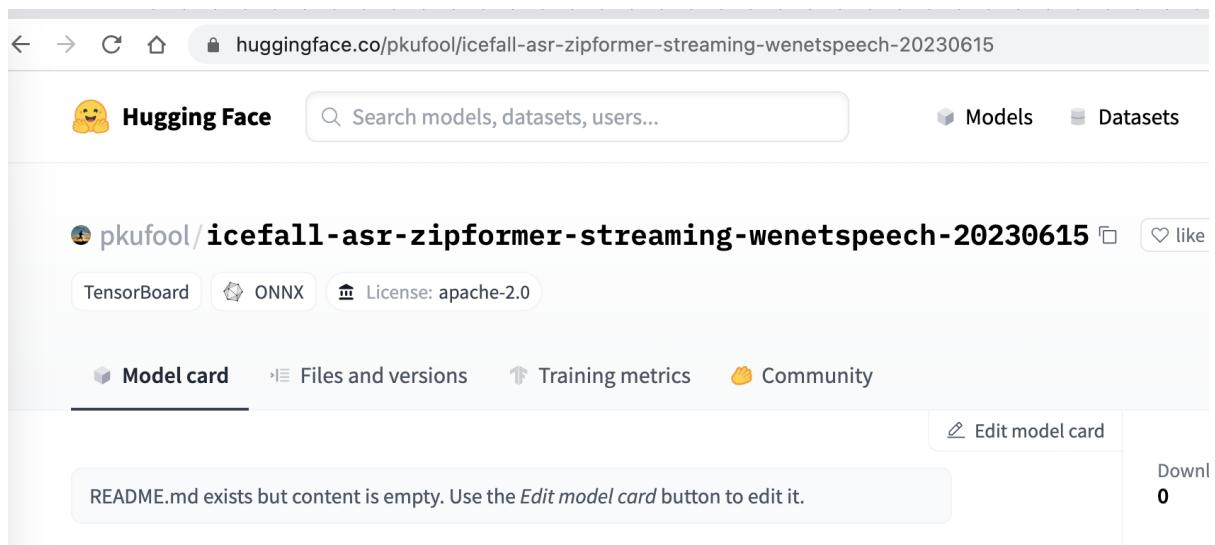
---

**Note:** It is very important to set the environment variable GIT\_LFS\_SKIP\_SMUDGE to 1. We don't recommend using git lfs install as it will download many large files that we don't need.

---

### 5.2.2 Using wget

First, let us visit the [huggingface git repository](https://huggingface.co/pkufool/icefall-asr-zipformer-streaming-wenetspeech-20230615) of the pre-trained model:



Click **Files and versions** and navigate to the directory containing files for downloading:

pkufool/icefall-asr-zipformer-streaming-wenetspeech-20230615

TensorBoard ONNX License: apache-2.0

Model card Files and versions Training metrics Community

main · icefall-asr-zipformer-streaming-wenetspeech-20230615 / exp

2 contributors

pkufool Merge branch 'main' of https://huggingface.co/pkufool/icefall-asr-zipformer-streaming-wenetspeech-20230615

tensorboard Add streaming zipformer model

decoder-epoch-12-avg-4-chunk-16-left-128.int8.onnx 3.12 MB LFS

decoder-epoch-12-avg-4-chunk-16-left-128.int8.onnx 12.4 MB LFS

decoder-epoch-12-avg-4-chunk-16-left-128.int8.onnx 3.12 MB LFS

decoder-epoch-12-avg-4-chunk-16-left-128.int8.onnx 12.4 MB LFS

decoder-epoch-12-avg-4-chunk-32-left-128.int8.onnx 3.12 MB LFS

decoder-epoch-12-avg-4-chunk-32-left-128.int8.onnx 12.4 MB LFS

Right click the arrow that indicates downloading and copy the link address. After that, you can use, for instance, `wget` to download the file with the following command:

```
wget https://huggingface.co/pkufool/icefall-asr-zipformer-streaming-wenetspeech-20230615/
  ↵resolve/main/exp/decoder-epoch-12-avg-4-chunk-16-left-128.int8.onnx
```

Repeat the process until you have downloaded all the required files.



# SHERPA

---

**Hint:** During speech recognition, it does not need to access the Internet. Everything is processed locally on your device.

---

k2-fsa/sherpa use PyTorch for neural network computation.

<https://k2-fsa.github.io/icefall/model-export/export-with-torch-jit-script.html> for how to export models.

In the following, we describe how to use k2-fsa/sherpa.

## 6.1 Installation

### 6.1.1 From pre-compiled wheels

---

**Note:** This method supports only Linux and macOS for now. If you want to use Windows, please refer to *From source*.

---

You can find a list of pre-compiled wheels at the following URLs:

- CPU: <https://k2-fsa.github.io/sherpa/cpu.html>
- CUDA: <https://k2-fsa.github.io/sherpa/cuda.html>

In the following, we demonstrate how to install k2-fsa/sherpa from pre-compiled wheels.

#### Linux (CPU)

Suppose that we want to install the following wheel

```
https://huggingface.co/csukuangfj/kaldifeat/resolve/main/ubuntu-cpu/k2_sherpa-1.3.  
-dev20230725+cpu.torch2.0.1-cp311-cp311-manylinux_2_17_x86_64.manylinux2014_x86_64.whl
```

we can use the following methods:

```
# Before installing k2-fsa/sherpa, we have to install the following dependencies:  
# torch, k2, and kaldifeat  
  
pip install torch==2.0.1+cpu -f https://download.pytorch.org/whl/torch_stable.html  
pip install k2==1.24.4.dev20231220+cpu.torch2.0.1 -f https://k2-fsa.github.io/k2/cpu.html  
pip install kaldifeat==1.25.3.dev20231221+cpu.torch2.0.1 -f https://csukuangfj.github.io/  
-kaldifeat/cpu.html
```

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```
# Now we can install k2-fsa/sherpa
pip install k2_sherpa==1.3.dev20230725+cpu.torch2.0.1 -f https://k2-fsa.github.io/sherpa/
˓→cpu.html
```

Please see [Check your installation](#).

## macOS (CPU)

Suppose that we want to install the following wheel

```
https://huggingface.co/csukuangfj/kaldifeat/resolve/main/macos/k2_sherpa-1.3.
˓→dev20230725+cpu.torch2.0.1-cp311-cp311-macosx_10_9_x86_64.whl
```

we can use the following methods:

```
# Before installing k2-fsa/sherpa, we have to install the following dependencies:
# torch, k2, and kaldifeat

pip install torch==2.0.1+cpu -f https://download.pytorch.org/whl/torch_stable.html
pip install k2==1.24.4.dev20231220+cpu.torch2.0.1 -f https://k2-fsa.github.io/k2/cpu.html
pip install kaldifeat==1.25.3.dev20231221+cpu.torch2.0.1 -f https://csukuangfj.github.io/
˓→kaldifeat/cpu.html

# Now we can install k2-fsa/sherpa
pip install k2_sherpa==1.3.dev20230725+cpu.torch2.0.1 -f https://k2-fsa.github.io/sherpa/
˓→cpu.html
```

Please see [Check your installation](#).

## Linux (CUDA)

Suppose that we want to install the following wheel

```
https://huggingface.co/csukuangfj/kaldifeat/resolve/main/ubuntu-cuda/k2_sherpa-1.3.
˓→dev20230725+cuda11.7.torch2.0.1-cp311-cp311-manylinux_2_17_x86_64.manylinux2014_x86_64.
˓→whl
```

we can use the following methods:

```
# Before installing k2-fsa/sherpa, we have to install the following dependencies:
# torch, k2, and kaldifeat

pip install torch==2.0.1+cu117 -f https://download.pytorch.org/whl/torch_stable.html
pip install k2==1.24.4.dev20231220+cuda11.7.torch2.0.1 -f https://k2-fsa.github.io/k2/
˓→cuda.html
pip install kaldifeat==1.25.3.dev20231221+cuda11.7.torch2.0.1 -f https://csukuangfj.
˓→github.io/kaldifeat/cuda.html

# Now we can install k2-fsa/sherpa
pip install k2_sherpa==1.3.dev20230725+cuda11.7.torch2.0.1 -f https://k2-fsa.github.io/
˓→sherpa/cuda.html
```

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Please see [Check your installation](#).

### 6.1.2 From source

This section describe how to install k2-fsa/sherpa from source.

#### Install dependencies

Before installing k2-fsa/sherpa from source, we have to install the following dependencies.

- PyTorch
- k2
- kaldifeat

CPU

CUDA

Suppose that we select `torch==2.0.1`. We can use the following commands to install the dependencies:

Linux

macOS

Windows

```
pip install torch==2.0.1+cpu -f https://download.pytorch.org/whl/torch_stable.html
pip install k2==1.24.4.dev20231220+cpu.torch2.0.1 -f https://k2-fsa.github.io/k2/cpu.html
pip install kaldifeat==1.25.3.dev20231221+cpu.torch2.0.1 -f https://csukuangfj.github.io/
↪ kaldifeat/cpu.html
```

```
pip install torch==2.0.1+cpu -f https://download.pytorch.org/whl/torch_stable.html
pip install k2==1.24.4.dev20231220+cpu.torch2.0.1 -f https://k2-fsa.github.io/k2/cpu.html
pip install kaldifeat==1.25.3.dev20231221+cpu.torch2.0.1 -f https://csukuangfj.github.io/
↪ kaldifeat/cpu.html
```

To be done.

Suppose that we select `torch==2.0.1+cu117`. We can use the following commands to install the dependencies:

```
pip install torch==2.0.1+cu117 -f https://download.pytorch.org/whl/torch_
↪ stable.html
pip install k2==1.24.4.dev20231220+cuda11.7.torch2.0.1 -f https://k2-fsa.
↪ github.io/k2/cuda.html
pip install kaldifeat==1.25.3.dev20231221+cuda11.7.torch2.0.1 -f https://
↪ csukuangfj.github.io/kaldifeat/cuda.html
```

Next, please follow <https://k2-fsa.github.io/k2/installation/cuda-cudnn.html> to install CUDA toolkit.

Now we can start to build k2-fsa/sherpa from source.

### For general users

You can use the following commands to install `k2-fsa/sherpa`:

```
# Please make sure you have installed PyTorch, k2, and kaldifeat
# before you continue
#
git clone http://github.com/k2-fsa/sherpa
cd sherpa
python3 -m pip install --verbose .
```

To uninstall `k2-fsa/sherpa`, please use

```
# Please run it outside of the k2-fsa/sherpa repo
#
pip uninstall k2-sherpa
```

Please see [Check your installation](#).

### For developers and advanced users

You can also use the following commands to install `k2-fsa/sherpa`.

The advantage is that you can have several versions of `k2-fsa/sherpa` in a single environment.

```
git clone http://github.com/k2-fsa/sherpa
cd sherpa
mkdir build
cd build

# For torch >= 2.0, please use
#
# cmake -DCMAKE_CXX_STANDARD=17 ..
#

cmake ..
make -j

export PATH=$PWD/bin:$PATH
export PYTHONPATH=$PWD/lib:$PWD/..sherpa/python:$PYTHONPATH
```

Please see [Check your installation](#).

#### 6.1.3 Check your installation

To check that you have installed `k2-fsa/sherpa` successfully, please run:

```
python3 -c "import sherpa; print(sherpa.__file__); print(sherpa.__version__)"

sherpa-online --help
sherpa-offline --help

sherpa-online-microphone --help
```

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```
sherpa-offline-microphone --help

sherpa-online-websocket-server --help
sherpa-online-websocket-client --help
sherpa-online-websocket-client-microphone --help

sherpa-offline-websocket-server --help
sherpa-offline-websocket-client --help
```

Congratulations! You have installed `k2-fsa/sherpa` successfully. Please refer to [Pre-trained models](#) to download pre-trained models.

Have fun with `k2-fsa/sherpa`!

We suggest that you install `k2-fsa/sherpa` by following [From pre-compiled wheels](#).

#### 6.1.4 Where to get help

If you have any issues about the installation, please create an issue at the following address:

<https://github.com/k2-fsa/sherpa/issues>

## 6.2 Pre-trained models

Two kinds of end-to-end (E2E) models are supported by `k2-fsa/sherpa`:

- CTC
- Transducer

---

**Hint:** For transducer-based models, we only support stateless transducers. To the best of our knowledge, only `icefall` supports that. In other words, only transducer models from `icefall` are currently supported.

For CTC-based models, we support any type of models trained using CTC loss as long as you can export the model via torchscript. Models from the following frameworks are currently supported: `icefall`, `WeNet`, and `torchaudio` (Wav2Vec 2.0). If you have a CTC model and want it to be supported in `k2-fsa/sherpa`, please create an issue at <https://github.com/k2-fsa/sherpa/issues>.

---

**Hint:** You can try the pre-trained models in your browser without installing anything. See <https://huggingface.co/spaces/k2-fsa/automatic-speech-recognition>.

---

This page lists all available pre-trained models that you can download.

---

**Hint:** We provide pre-trained models for the following languages:

- Arabic
- Chinese
- English
- German

- Tibetan
- 

**Hint:** We provide a colab notebook for you to try offline recognition step by step.

It shows how to install sherpa and use it as offline recognizer, which supports the models from icefall, the WeNet framework and torchaudio.

---

### 6.2.1 Offline CTC models

This sections list pre-trained CTC models from the following frameworks:

#### icefall

**Hint:** We use the binary `sherpa-offline` below for demonstration. You can replace `sherpa-offline` with `sherpa-offline-websocket-server`.

---

In this section, we list all pre-trained CTC models from icefall.

##### icefall-asr-gigaspeech-conformer-ctc (English)

```
# This model is trained using GigaSpeech
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/wgb14/icefall-asr-gigaspeech-
˓→conformer-ctc
cd icefall-asr-gigaspeech-conformer-ctc
git lfs pull --include "exp/cpu_jit.pt"
git lfs pull --include "data/lang_bpe_500/HLG.pt"
git lfs pull --include "data/lang_bpe_500/tokens.txt"
mkdir test_wavs
cd test_wavs
wget https://huggingface.co/csukuangfj/wav2vec2.0-torchaudio/resolve/main/test_wavs/1089-
˓→134686-0001.wav
wget https://huggingface.co/csukuangfj/wav2vec2.0-torchaudio/resolve/main/test_wavs/1221-
˓→135766-0001.wav
wget https://huggingface.co/csukuangfj/wav2vec2.0-torchaudio/resolve/main/test_wavs/1221-
˓→135766-0002.wav
cd ..

# Decode with H
sherpa-offline \
--nn-model=./exp/cpu_jit.pt \
--tokens=./data/lang_bpe_500/tokens.txt \
./test_wavs/1089-134686-0001.wav \
./test_wavs/1221-135766-0001.wav \
./test_wavs/1221-135766-0002.wav

# Decode with HLG
sherpa-offline \
```

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```
--nn-model=./exp/cpu_jit.pt \
--hlg=./data/lang_bpe_500/HLG.pt \
--tokens=./data/lang_bpe_500/tokens.txt \
./test_wavs/1089-134686-0001.wav \
./test_wavs/1221-135766-0001.wav \
./test_wavs/1221-135766-0002.wav
```

### icefall-asr-librispeech-conformer-ctc-jit-bpe-500-2021-11-09 (English)

```
GIT-lfs_SKIP_SMUDGE=1 git clone https://huggingface.co/csukuangfj/icefall-asr-
↪ librispeech-conformer-ctc-jit-bpe-500-2021-11-09
cd icefall-asr-librispeech-conformer-ctc-jit-bpe-500-2021-11-09

git lfs pull --include "exp/cpu_jit.pt"
git lfs pull --include "data/lang_bpe_500/tokens.txt"
git lfs pull --include "data/lang_bpe_500/HLG.pt"
git lfs pull --include "data/lang_bpe_500/HLG_modified.pt"

# Decode with H
sherpa-offline \
--nn-model=./exp/cpu_jit.pt \
--tokens=./data/lang_bpe_500/tokens.txt \
--use-gpu=false \
./test_wavs/1089-134686-0001.wav \
./test_wavs/1221-135766-0001.wav \
./test_wavs/1221-135766-0002.wav

# Decode with HLG
sherpa-offline \
--nn-model=./exp/cpu_jit.pt \
--tokens=./data/lang_bpe_500/tokens.txt \
--hlg=./data/lang_bpe_500/HLG.pt \
--use-gpu=false \
./test_wavs/1089-134686-0001.wav \
./test_wavs/1221-135766-0001.wav \
./test_wavs/1221-135766-0002.wav

# Decode with HLG (modified)
sherpa-offline \
--nn-model=./exp/cpu_jit.pt \
--tokens=./data/lang_bpe_500/tokens.txt \
--hlg=./data/lang_bpe_500/HLG_modified.pt \
--use-gpu=false \
./test_wavs/1089-134686-0001.wav \
./test_wavs/1221-135766-0001.wav \
./test_wavs/1221-135766-0002.wav
```

### icefall-asr-tedlium3-conformer-ctc2 (English)

```
# This model is trained using Tedlium3
#
# See https://github.com/k2-fsa/icefall/pull/696
#
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/videodanchik/icefall-asr-tedlium3-
˓ conformer-ctc2
cd icefall-asr-tedlium3-conformer-ctc2
git lfs pull --include "exp/cpu_jit.pt"

git lfs pull --include "data/lang_bpe/HLG.pt"
git lfs pull --include "data/lang_bpe/tokens.txt"

git lfs pull --include "test_wavs/DanBarber_2010-219.wav"
git lfs pull --include "test_wavs/DanielKahneman_2010-157.wav"
git lfs pull --include "test_wavs/RobertGupta_2010U-15.wav"

# Decode with H
sherpa-offline \
--nn-model=./exp/cpu_jit.pt \
--tokens=./data/lang_bpe/tokens.txt \
./test_wavs/DanBarber_2010-219.wav \
./test_wavs/DanielKahneman_2010-157.wav \
./test_wavs/RobertGupta_2010U-15.wav

# Decode with HLG
sherpa-offline \
--nn-model=./exp/cpu_jit.pt \
--hlg=./data/lang_bpe/HLG.pt \
--tokens=./data/lang_bpe/tokens.txt \
./test_wavs/DanBarber_2010-219.wav \
./test_wavs/DanielKahneman_2010-157.wav \
./test_wavs/RobertGupta_2010U-15.wav
```

### icefall\_asr\_librispeech\_conformer\_ctc (English)

```
# This model is trained using LibriSpeech
#
# See https://github.com/k2-fsa/icefall/pull/13
#
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/pkufool/icefall_asr_librispeech-
˓ conformer_ctc
cd icefall_asr_librispeech_conformer_ctc

git lfs pull --include "exp/cpu_jit.pt"
git lfs pull --include "data/lang_bpe/HLG.pt"

# Decode with H
```

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```
sherpa-offline \
  --nn-model=./exp/cpu_jit.pt \
  --tokens=./data/lang_bpe/tokens.txt \
  ./test_wavs/1089-134686-0001.wav \
  ./test_wavs/1221-135766-0001.wav \
  ./test_wavs/1221-135766-0002.wav

# Decode with HLG
sherpa-offline \
  --nn-model=./exp/cpu_jit.pt \
  --hlg=./data/lang_bpe/HLG.pt \
  --tokens=./data/lang_bpe/tokens.txt \
  ./test_wavs/1089-134686-0001.wav \
  ./test_wavs/1221-135766-0001.wav \
  ./test_wavs/1221-135766-0002.wav
```

### icefall\_asr\_aishell\_conformer\_ctc (Chinese)

```
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/pkufool/icefall_asr_aishell_
→conformer_ctc
cd icefall_asr_aishell_conformer_ctc
git lfs pull --include "exp/cpu_jit.pt"
git lfs pull --include "data/lang_char/HLG.pt"

# Decode with an H graph
sherpa-offline \
  --nn-model=./exp/cpu_jit.pt \
  --tokens=./data/lang_char/tokens.txt \
  ./test_waves/BAC009S0764W0121.wav \
  ./test_waves/BAC009S0764W0122.wav \
  ./test_waves/BAC009S0764W0123.wav

# Decode with an HLG graph
sherpa-offline \
  --nn-model=./exp/cpu_jit.pt \
  --tokens=./data/lang_char/tokens.txt \
  --hlg=./data/lang_char/HLG.pt \
  ./test_waves/BAC009S0764W0121.wav \
  ./test_waves/BAC009S0764W0122.wav \
  ./test_waves/BAC009S0764W0123.wav
```

### icefall-asr-mgb2-conformer\_ctc-2022-27-06 (Arabic)

```
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/AmirHussein/icefall-asr-mgb2-  
→conformer_ctc-2022-27-06  
cd icefall-asr-mgb2-conformer_ctc-2022-27-06  
git lfs pull --include "exp/cpu_jit.pt"  
git lfs pull --include "data/lang_bpe_5000/HLG.pt"  
git lfs pull --include "data/lang_bpe_5000/tokens.txt"  
  
# Decode with an H graph  
sherpa-offline \  
--nn-model=./exp/cpu_jit.pt \  
--tokens=./data/lang_bpe_5000/tokens.txt \  
./test_wavs/94D37D38-B203-4FC0-9F3A-538F5C174920_spk-0001_seg-0053813:0054281.wav \  
./test_wavs/94D37D38-B203-4FC0-9F3A-538F5C174920_spk-0001_seg-0051454:0052244.wav \  
./test_wavs/94D37D38-B203-4FC0-9F3A-538F5C174920_spk-0001_seg-0052244:0053004.wav  
  
# Decode with an HLG graph  
sherpa-offline \  
--nn-model=./exp/cpu_jit.pt \  
--tokens=./data/lang_bpe_5000/tokens.txt \  
--hlg=./data/lang_bpe_5000/HLG.pt \  
./test_wavs/94D37D38-B203-4FC0-9F3A-538F5C174920_spk-0001_seg-0053813:0054281.wav \  
./test_wavs/94D37D38-B203-4FC0-9F3A-538F5C174920_spk-0001_seg-0051454:0052244.wav \  
./test_wavs/94D37D38-B203-4FC0-9F3A-538F5C174920_spk-0001_seg-0052244:0053004.wav
```

## WeNet

This section lists models from WeNet.

### wenet-english-model (English)

```
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/csukuangfj/wenet-english-model  
cd wenet-english-model  
git lfs pull --include "final.zip"  
  
sherpa-offline \  
--normalize-samples=false \  
--modified=true \  
--nn-model=./final.zip \  
--tokens=./units.txt \  
--use-gpu=false \  
./test_wavs/1089-134686-0001.wav \  
./test_wavs/1221-135766-0001.wav \  
./test_wavs/1221-135766-0002.wav
```

**wenet-chinese-model (Chinese)**

```
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/csukuangfj/wenet-chinese-model
cd wenet-chinese-model
git lfs pull --include "final.zip"

sherpa-offline \
--normalize-samples=false \
--modified=true \
--nn-model=./final.zip \
--tokens=./units.txt \
./test_wavs/BAC009S0764W0121.wav \
./test_wavs/BAC009S0764W0122.wav \
./test_wavs/BAC009S0764W0123.wav \
./test_wavs/DEV_T0000000000.wav \
./test_wavs/DEV_T0000000001.wav \
./test_wavs/DEV_T0000000002.wav
```

**torchaudio**

This section lists models from torchaudio.

**wav2vec2\_asr\_base (English)**

```
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/csukuangfj/wav2vec2.0-torchaudio
cd wav2vec2.0-torchaudio

# Note: There are other kinds of models fine-tuned with different
# amount of data. We use a model that is fine-tuned with 10 minutes of data.

git lfs pull --include "wav2vec2_asr_base_10m.pt"

sherpa-offline \
--nn-model=wav2vec2_asr_base_10m.pt \
--tokens=tokens.txt \
--use-gpu=false \
./test_wavs/1089-134686-0001.wav \
./test_wavs/1221-135766-0001.wav \
./test_wavs/1221-135766-0002.wav
```

**voxpupuli\_asr\_base (German)**

```
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/csukuangfj/wav2vec2.0-torchaudio
cd wav2vec2.0-torchaudio
git lfs pull --include "voxpupuli_asr_base_10k_de.pt"

sherpa-offline \
--nn-model=voxpupuli_asr_base_10k_de.pt \
```

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```
--tokens=tokens-de.txt \
--use-gpu=false \
./test_wavs/20120315-0900-PLENARY-14-de_20120315.wav \
./test_wavs/20170517-0900-PLENARY-16-de_20170517.wav
```

## NeMo

This section lists models from **NeMo**.

### sherpa-nemo-ctc-en-citrinet-512 (English)

This model is converted from

[https://catalog.ngc.nvidia.com/orgs/nvidia/teams/nemo/models/stt\\_en\\_citrinet\\_512](https://catalog.ngc.nvidia.com/orgs/nvidia/teams/nemo/models/stt_en_citrinet_512)

```
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/csukuangfj/sherpa-nemo-ctc-en-
↪citrinet-512
cd sherpa-nemo-ctc-en-citrinet-512
git lfs pull --include "model.pt"

sherpa-offline \
--nn-model=./model.pt \
--tokens=./tokens.txt \
--use-gpu=false \
--modified=false \
--nemo-normalize=per_feature \
./test_wavs/0.wav \
./test_wavs/1.wav \
./test_wavs/2.wav
```

```
ls -lh model.pt
-rw-r--r-- 1 kuangfangjun root 142M Mar  9 21:23 model.pt
```

**Caution:** It is of paramount importance to specify `--nemo-normalize=per_feature`.

### sherpa-nemo-ctc-zh-citrinet-512 (Chinese)

This model is converted from

[https://catalog.ngc.nvidia.com/orgs/nvidia/teams/nemo/models/stt\\_zh\\_citrinet\\_512](https://catalog.ngc.nvidia.com/orgs/nvidia/teams/nemo/models/stt_zh_citrinet_512)

```
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/csukuangfj/sherpa-nemo-ctc-zh-
↪citrinet-512
cd sherpa-nemo-ctc-zh-citrinet-512
git lfs pull --include "model.pt"

sherpa-offline \
--nn-model=./model.pt \
```

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```
--tokens=./tokens.txt \
--use-gpu=false \
--modified=true \
--nemo-normalize=per_feature \
./test_wavs/0.wav \
./test_wavs/1.wav \
./test_wavs/2.wav
```

```
ls -lh model.pt
-rw-r--r-- 1 kuangfangjun root 153M Mar 10 15:07 model.pt
```

**Hint:** Since the vocabulary size of this model is very large, i.e, 5207, we use `--modified=true` to use a modified CTC topology

**Caution:** It is of paramount importance to specify `--nemo-normalize=per_feature`.

### sherpa-nemo-ctc-zh-citrinet-1024-gamma-0-25 (Chinese)

This model is converted from

[https://catalog.ngc.nvidia.com/orgs/nvidia/teams/nemo/models/stt\\_zh\\_citrinet\\_1024\\_gamma\\_0\\_25](https://catalog.ngc.nvidia.com/orgs/nvidia/teams/nemo/models/stt_zh_citrinet_1024_gamma_0_25)

```
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/csukuangfj/sherpa-nemo-ctc-zh-
˓→citrinet-1024-gamma-0-25
cd sherpa-nemo-ctc-zh-citrinet-1024-gamma-0-25
git lfs pull --include "model.pt"

sherpa-offline \
--nn-model=./model.pt \
--tokens=./tokens.txt \
--use-gpu=false \
--modified=true \
--nemo-normalize=per_feature \
./test_wavs/0.wav \
./test_wavs/1.wav \
./test_wavs/2.wav
```

```
ls -lh model.pt
-rw-r--r-- 1 kuangfangjun root 557M Mar 10 16:29 model.pt
```

**Hint:** Since the vocabulary size of this model is very large, i.e, 5207, we use `--modified=true` to use a modified CTC topology

**Caution:** It is of paramount importance to specify `--nemo-normalize=per_feature`.

### sherpa-nemo-ctc-de-citrinet-1024 (German)

This model is converted from

[https://catalog.ngc.nvidia.com/orgs/nvidia/teams/nemo/models/stt\\_de\\_citrinet\\_1024](https://catalog.ngc.nvidia.com/orgs/nvidia/teams/nemo/models/stt_de_citrinet_1024)

```
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/csukuangfj/sherpa-nemo-ctc-de-  
↳ citrinet-1024  
cd sherpa-nemo-ctc-de-citrinet-1024  
git lfs pull --include "model.pt"  
  
sherpa-offline \  
  --nn-model=./model.pt \  
  --tokens=./tokens.txt \  
  --use-gpu=false \  
  --modified=false \  
  --nemo-normalize=per_feature \  
  ./test_wavs/0.wav \  
  ./test_wavs/1.wav \  
  ./test_wavs/2.wav
```

```
ls -lh model.pt  
-rw-r--r-- 1 kuangfangjun root 541M Mar 10 16:55 model.pt
```

**Caution:** It is of paramount importance to specify `--nemo-normalize=per_feature`.

### sherpa-nemo-ctc-en-conformer-small (English)

This model is converted from

[https://registry.ngc.nvidia.com/orgs/nvidia/teams/nemo/models/stt\\_en\\_conformer\\_ctc\\_small](https://registry.ngc.nvidia.com/orgs/nvidia/teams/nemo/models/stt_en_conformer_ctc_small)

```
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/csukuangfj/sherpa-nemo-ctc-en-  
↳ conformer-small  
cd sherpa-nemo-ctc-en-conformer-small  
git lfs pull --include "model.pt"  
  
sherpa-offline \  
  --nn-model=./model.pt \  
  --tokens=./tokens.txt \  
  --use-gpu=false \  
  --modified=false \  
  --nemo-normalize=per_feature \  
  ./test_wavs/0.wav \  
  ./test_wavs/1.wav \  
  ./test_wavs/2.wav
```

```
ls -lh model.pt  
-rw-r--r-- 1 fangjun staff 82M Mar 10 19:55 model.pt
```

**Caution:** It is of paramount importance to specify `--nemo-normalize=per_feature`.

## sherpa-nemo-ctc-en-conformer-medium (English)

This model is converted from

[https://registry.ngc.nvidia.com/orgs/nvidia/teams/nemo/models/stt\\_en\\_conformer\\_ctc\\_medium](https://registry.ngc.nvidia.com/orgs/nvidia/teams/nemo/models/stt_en_conformer_ctc_medium)

```
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/csukuangfj/sherpa-nemo-ctc-en-  
conformer-medium  
cd sherpa-nemo-ctc-en-conformer-medium  
git lfs pull --include "model.pt"  
  
sherpa-offline \  
--nn-model=./model.pt \  
--tokens=./tokens.txt \  
--use-gpu=false \  
--modified=false \  
--nemo-normalize=per_feature \  
./test_wavs/0.wav \  
./test_wavs/1.wav \  
./test_wavs/2.wav
```

```
ls -lh model.pt
-rw-r--r-- 1 fangjun staff 152M Mar 10 20:26 model.pt
```

**Caution:** It is of paramount importance to specify `--nemo-normalize=per_feature`.

## sherpa-nemo-ctc-en-conformer-large (English)

This model is converted from

[https://registry.ngc.nvidia.com/orgs/nvidia/teams/nemo/models/stt\\_en\\_conformer\\_ctc\\_large](https://registry.ngc.nvidia.com/orgs/nvidia/teams/nemo/models/stt_en_conformer_ctc_large)

**Hint:** The vocabulary size is 129

```
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/csukuangfj/sherpa-nemo-ctc-en-  
→conformer-large  
cd sherpa-nemo-ctc-en-conformer-large  
git lfs pull --include "model.pt"  
  
sherpa-offline \  
  --nn-model=./model.pt \  
  --tokens=./tokens.txt \  
  --use-gpu=false \  
  --modified=false \  
  --nemo-normalize=per_feature \  
  --nemo-parallel=4
```

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```
./test_wavs/0.wav \
./test_wavs/1.wav \
./test_wavs/2.wav
```

```
ls -lh model.pt
-rw-r--r-- 1 fangjun staff 508M Mar 10 20:44 model.pt
```

**Caution:** It is of paramount importance to specify `--nemo-normalize=per_feature`.

### sherpa-nemo-ctc-de-conformer-large (German)

This model is converted from

[https://registry.ngc.nvidia.com/orgs/nvidia/teams/nemo/models/stt\\_de\\_conformer\\_ctc\\_large](https://registry.ngc.nvidia.com/orgs/nvidia/teams/nemo/models/stt_de_conformer_ctc_large)

---

**Hint:** The vocabulary size is 129

---

```
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/csukuangfj/sherpa-nemo-ctc-de-
˓→conformer-large
cd sherpa-nemo-ctc-de-conformer-large
git lfs pull --include "model.pt"

sherpa-offline \
--nn-model=./model.pt \
--tokens=./tokens.txt \
--use-gpu=false \
--modified=false \
--nemo-normalize=per_feature \
./test_wavs/0.wav \
./test_wavs/1.wav \
./test_wavs/2.wav
```

```
ls -lh model.pt
-rw-r--r-- 1 fangjun staff 508M Mar 10 21:34 model.pt
```

**Caution:** It is of paramount importance to specify `--nemo-normalize=per_feature`.

## How to convert NeMo models to sherpa

This section describes how to export NeMo pre-trained CTC models to sherpa.

You can find a list of pre-trained models from NeMo by visiting:

[https://catalog.ngc.nvidia.com/orgs/nvidia/collections/nemo\\_asr](https://catalog.ngc.nvidia.com/orgs/nvidia/collections/nemo_asr).

Let us take `stt_en_conformer_ctc_small` as an example.

You can use the following code to obtain `model.pt` and `tokens.txt`:

```
import nemo.collections.asr as nemo_asr
m = nemo_asr.models.EncDecCTCModelBPE.from_pretrained('stt_en_conformer_ctc_small')
m.export("model.pt")

with open('tokens.txt', 'w', encoding='utf-8') as f:
    f.write("<blk> 0\n")
    for i, s in enumerate(m.decoder.vocabulary):
        f.write(f"{s} {i+1}\n")
```

One thing to note is that the blank token has the largest token ID in NeMo. However, it is always `0` in sherpa. During network computation, we shift the last column of the `log_prob` tensor to the first column so that it matches the convention about using 0 for the blank in sherpa.

You can find the exported `model.pt` and `tokens.txt` by visiting

<https://huggingface.co/csukuangfj/sherpa-nemo-ctc-en-conformer-small>

### 6.2.2 Offline transducer models

---

**Hint:** We use the binary `sherpa-offline` below for demonstration. You can replace `sherpa-offline` with `sherpa-offline-websocket-server`.

---



---

**Hint:** Please visit <https://huggingface.co/spaces/k2-fsa/automatic-speech-recognition> to try the pre-trained models in your browser. You don't need to install anything.

---

#### icefall

This sections lists models trained using `icefall`.

##### English

###### **icefall-asr-librispeech-zipformer-2023-05-15**

```
# This model is trained using LibriSpeech with zipformer transducer
#
# See https://github.com/k2-fsa/icefall/pull/1058
#
```

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```

# normal-scaled model, number of model parameters: 65549011, i.e., 65.55 M
#
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/Zengwei/icefall-asr-librispeech-
zipformer-2023-05-15
cd icefall-asr-librispeech-zipformer-2023-05-15

git lfs pull --include "exp/jit_script.pt"
git lfs pull --include "data/lang_bpe_500/LG.pt"

for m in greedy_search modified_beam_search fast_beam_search; do
    sherpa-offline \
        --decoding-method=$m \
        --nn-model=./exp/jit_script.pt \
        --tokens=./data/lang_bpe_500/tokens.txt \
        ./test_wavs/1089-134686-0001.wav \
        ./test_wavs/1221-135766-0001.wav \
        ./test_wavs/1221-135766-0002.wav
done

sherpa-offline \
    --decoding-method=fast_beam_search \
    --nn-model=./exp/jit_script.pt \
    --lg=./data/lang_bpe_500/LG.pt \
    --tokens=./data/lang_bpe_500/tokens.txt \
    ./test_wavs/1089-134686-0001.wav \
    ./test_wavs/1221-135766-0001.wav \
    ./test_wavs/1221-135766-0002.wav

```

**icefall-asr-librispeech-zipformer-small-2023-05-16**

```

# This model is trained using LibriSpeech with zipformer transducer
#
# See https://github.com/k2-fsa/icefall/pull/1058
#
# small-scaled model, number of model parameters: 23285615, i.e., 23.3 M
#
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/Zengwei/icefall-asr-librispeech-
zipformer-small-2023-05-16
cd icefall-asr-librispeech-zipformer-small-2023-05-16

git lfs pull --include "exp/jit_script.pt"
git lfs pull --include "data/lang_bpe_500/LG.pt"

for m in greedy_search modified_beam_search fast_beam_search; do
    sherpa-offline \
        --decoding-method=$m \
        --nn-model=./exp/jit_script.pt \
        --tokens=./data/lang_bpe_500/tokens.txt \
        ./test_wavs/1089-134686-0001.wav \
        ./test_wavs/1221-135766-0001.wav \

```

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```

./test_wavs/1221-135766-0002.wav
done

sherpa-offline \
--decoding-method=fast_beam_search \
--nn-model=./exp/jit_script.pt \
--lg=./data/lang_bpe_500/LG.pt \
--tokens=./data/lang_bpe_500/tokens.txt \
./test_wavs/1089-134686-0001.wav \
./test_wavs/1221-135766-0001.wav \
./test_wavs/1221-135766-0002.wav

```

### icefall-asr-librispeech-zipformer-large-2023-05-16

```

# This model is trained using LibriSpeech with zipformer transducer
#
# See https://github.com/k2-fsa/icefall/pull/1058
#
# large-scaled model, number of model parameters: 148439574, i.e., 148.4 M
#
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/Zengwei/icefall-asr-librispeech-
↪zipformer-large-2023-05-16
cd icefall-asr-librispeech-zipformer-large-2023-05-16

git lfs pull --include "exp/jit_script.pt"
git lfs pull --include "data/lang_bpe_500/LG.pt"

for m in greedy_search modified_beam_search fast_beam_search; do
    sherpa-offline \
        --decoding-method=$m \
        --nn-model=./exp/jit_script.pt \
        --tokens=./data/lang_bpe_500/tokens.txt \
        ./test_wavs/1089-134686-0001.wav \
        ./test_wavs/1221-135766-0001.wav \
        ./test_wavs/1221-135766-0002.wav
done

sherpa-offline \
--decoding-method=fast_beam_search \
--nn-model=./exp/jit_script.pt \
--lg=./data/lang_bpe_500/LG.pt \
--tokens=./data/lang_bpe_500/tokens.txt \
./test_wavs/1089-134686-0001.wav \
./test_wavs/1221-135766-0001.wav \
./test_wavs/1221-135766-0002.wav

```

### icefall-asr-multidataset-pruned\_transducer\_stateless7-2023-05-04

```
# This model is trained using GigaSpeech + LibriSpeech + Common Voice 13.0 with zipformer
#
# See https://github.com/k2-fsa/icefall/pull/1010
#
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/yfyeung/icefall-asr-multidataset-
˓→pruned_transducer_stateless7-2023-05-04
cd icefall-asr-multidataset-pruned_transducer_stateless7-2023-05-04
git lfs pull --include "exp/cpu_jit-epoch-30-avg-4.pt"
cd exp
ln -s cpu_jit-epoch-30-avg-4.pt cpu_jit.pt
cd ..

for m in greedy_search modified_beam_search fast_beam_search; do
    sherpa-offline \
        --decoding-method=$m \
        --nn-model=./exp/cpu_jit.pt \
        --tokens=./data/lang_bpe_500/tokens.txt \
        ./test_wavs/1089-134686-0001.wav \
        ./test_wavs/1221-135766-0001.wav \
        ./test_wavs/1221-135766-0002.wav
done
```

### icefall-asr-librispeech-pruned-transducer-stateless8-2022-12-02

```
# This model is trained using GigaSpeech + LibriSpeech with zipformer
#
# See https://github.com/k2-fsa/icefall/pull/728
#
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/WeijiZhuang/icefall-asr-
˓→librispeech-pruned-transducer-stateless8-2022-12-02
cd icefall-asr-librispeech-pruned-transducer-stateless8-2022-12-02
git lfs pull --include "exp/cpu_jit-torch-1.10.pt"
git lfs pull --include "data/lang_bpe_500/LG.pt"

cd exp
rm cpu_jit.pt
ln -sv cpu_jit-torch-1.10.pt cpu_jit.pt
cd ..

for m in greedy_search modified_beam_search fast_beam_search; do
    sherpa-offline \
        --decoding-method=$m \
        --nn-model=./exp/cpu_jit.pt \
        --tokens=./data/lang_bpe_500/tokens.txt \
        ./test_wavs/1089-134686-0001.wav \
        ./test_wavs/1221-135766-0001.wav \
        ./test_wavs/1221-135766-0002.wav
done
```

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```
sherpa-offline \
  --decoding-method=fast_beam_search \
  --nn-model=./exp/cpu_jit.pt \
  --lg=./data/lang_bpe_500/LG.pt \
  --tokens=./data/lang_bpe_500/tokens.txt \
  ./test_wavs/1089-134686-0001.wav \
  ./test_wavs/1221-135766-0001.wav \
  ./test_wavs/1221-135766-0002.wav
```

**icefall-asr-librispeech-pruned-transducer-stateless8-2022-11-14**

```
# This model is trained using GigaSpeech + LibriSpeech with zipformer
#
# See https://github.com/k2-fsa/icefall/pull/675
#
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/csukuangfj/icefall-asr-
↪ librispeech-pruned-transducer-stateless8-2022-11-14
cd icefall-asr-librispeech-pruned-transducer-stateless8-2022-11-14
git lfs pull --include "exp/cpu_jit.pt"
git lfs pull --include "data/lang_bpe_500/LG.pt"

for m in greedy_search modified_beam_search fast_beam_search; do
  sherpa-offline \
    --decoding-method=$m \
    --nn-model=./exp/cpu_jit.pt \
    --tokens=./data/lang_bpe_500/tokens.txt \
    ./test_wavs/1089-134686-0001.wav \
    ./test_wavs/1221-135766-0001.wav \
    ./test_wavs/1221-135766-0002.wav
done

sherpa-offline \
  --decoding-method=fast_beam_search \
  --nn-model=./exp/cpu_jit.pt \
  --lg=./data/lang_bpe_500/LG.pt \
  --tokens=./data/lang_bpe_500/tokens.txt \
  ./test_wavs/1089-134686-0001.wav \
  ./test_wavs/1221-135766-0001.wav \
  ./test_wavs/1221-135766-0002.wav
```

**icefall-asr-librispeech-pruned-transducer-stateless7-2022-11-11**

```
# This model is trained using LibriSpeech with zipformer
#
# See https://github.com/k2-fsa/icefall/pull/672
#
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/csukuangfj/icefall-asr-
↪ librispeech-pruned-transducer-stateless7-2022-11-11
```

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```
cd icefall-asr-librispeech-pruned-transducer-stateless7-2022-11-11
git lfs pull --include "exp/cpu_jit-torch-1.10.0.pt"
git lfs pull --include "data/lang_bpe_500/LG.pt"
cd exp
ln -s cpu_jit-torch-1.10.0.pt cpu_jit.pt
cd ..

for m in greedy_search modified_beam_search fast_beam_search; do
    sherpa-offline \
        --decoding-method=$m \
        --nn-model=./exp/cpu_jit.pt \
        --tokens=./data/lang_bpe_500/tokens.txt \
        ./test_wavs/1089-134686-0001.wav \
        ./test_wavs/1221-135766-0001.wav \
        ./test_wavs/1221-135766-0002.wav
done

sherpa-offline \
    --decoding-method=fast_beam_search \
    --nn-model=./exp/cpu_jit.pt \
    --lg=./data/lang_bpe_500/LG.pt \
    --tokens=./data/lang_bpe_500/tokens.txt \
    ./test_wavs/1089-134686-0001.wav \
    ./test_wavs/1221-135766-0001.wav \
    ./test_wavs/1221-135766-0002.wav
```

### icefall-asr-librispeech-pruned-transducer-stateless3-2022-05-13

```
# This model is trained using LibriSpeech + GigaSpeech
#
# See https://github.com/k2-fsa/icefall/pull/363
#
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/csukuangfj/icefall-asr-
librispeech-pruned-transducer-stateless3-2022-05-13
cd icefall-asr-librispeech-pruned-transducer-stateless3-2022-05-13
git lfs pull --include "exp/cpu_jit.pt"
git lfs pull --include "data/lang_bpe_500/LG.pt"

for m in greedy_search modified_beam_search fast_beam_search; do
    sherpa-offline \
        --decoding-method=$m \
        --nn-model=./exp/cpu_jit.pt \
        --tokens=./data/lang_bpe_500/tokens.txt \
        ./test_wavs/1089-134686-0001.wav \
        ./test_wavs/1221-135766-0001.wav \
        ./test_wavs/1221-135766-0002.wav
done

sherpa-offline \
    --decoding-method=fast_beam_search \
```

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```
--nn-model=./exp/cpu_jit.pt \
--lg=./data/lang_bpe_500/LG.pt \
--tokens=./data/lang_bpe_500/tokens.txt \
./test_wavs/1089-134686-0001.wav \
./test_wavs/1221-135766-0001.wav \
./test_wavs/1221-135766-0002.wav
```

## icefall-asr-gigaspeech-pruned-transducer-stateless2

```
# This model is trained using GigaSpeech
#
# See https://github.com/k2-fsa/icefall/pull/318
#
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/wgb14/icefall-asr-gigaspeech-
˓→pruned-transducer-stateless2
cd icefall-asr-gigaspeech-pruned-transducer-stateless2
git lfs pull --include "exp/cpu_jit-iter-3488000-avg-15.pt"
git lfs pull --include "data/lang_bpe_500/bpe.model"

cd ../exp
ln -s cpu_jit-iter-3488000-avg-15.pt cpu_jit.pt
cd ..

# Since this repo does not provide tokens.txt, we generate it from bpe.model
# by ourselves
/path/to/sherpa/scripts/bpe_model_to_tokens.py ./data/lang_bpe_500/bpe.model > ./data/
˓→lang_bpe_500/tokens.txt

mkdir test_wavs
cd test_wavs
wget https://huggingface.co/csukuangfj/wav2vec2.0-torchaudio/resolve/main/test_wavs/1089-
˓→134686-0001.wav
wget https://huggingface.co/csukuangfj/wav2vec2.0-torchaudio/resolve/main/test_wavs/1221-
˓→135766-0001.wav
wget https://huggingface.co/csukuangfj/wav2vec2.0-torchaudio/resolve/main/test_wavs/1221-
˓→135766-0002.wav

for m in greedy_search modified_beam_search fast_beam_search; do
    sherpa-offline \
        --decoding-method=$m \
        --nn-model=./exp/cpu_jit.pt \
        --tokens=./data/lang_bpe_500/tokens.txt \
        ./test_wavs/1089-134686-0001.wav \
        ./test_wavs/1221-135766-0001.wav \
        ./test_wavs/1221-135766-0002.wav
done
```

**Chinese****icefall\_asr\_wenetspeech\_pruned\_transducer\_stateless2**

```
# This models is trained using WenetSpeech
#
# See https://github.com/k2-fsa/icefall/pull/349
#
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/luomingshuang/icefall_asr_
-wenetspeech_pruned_transducer_stateless2

cd icefall_asr_wenetspeech_pruned_transducer_stateless2
git lfs pull --include "exp/cpu_jit_epoch_10_avg_2_torch_1.7.1.pt"
git lfs pull --include "data/lang_char/LG.pt"
cd exp
ln -s cpu_jit_epoch_10_avg_2_torch_1.7.1.pt cpu_jit.pt
cd ..

for m in greedy_search modified_beam_search fast_beam_search; do
    sherpa-offline \
        --decoding-method=$m \
        --nn-model=./exp/cpu_jit.pt \
        --tokens=./data/lang_char/tokens.txt \
        ./test_wavs/DEV_T0000000000.wav \
        ./test_wavs/DEV_T0000000001.wav \
        ./test_wavs/DEV_T0000000002.wav
done

sherpa-offline \
    --decoding-method=$m \
    --nn-model=./exp/cpu_jit.pt \
    --lg=./data/lang_char/LG.pt \
    --tokens=./data/lang_char/tokens.txt \
    ./test_wavs/DEV_T0000000000.wav \
    ./test_wavs/DEV_T0000000001.wav \
    ./test_wavs/DEV_T0000000002.wav
```

**icefall\_asr\_aidatatang-200zh\_pruned\_transducer\_stateless2**

```
# This models is trained using aidatatang_200zh
#
# See https://github.com/k2-fsa/icefall/pull/355
#
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/luomingshuang/icefall_asr_
-aidatatang-200zh_pruned_transducer_stateless2
cd icefall_asr_aidatatang-200zh_pruned_transducer_stateless2
git lfs pull --include "exp/cpu_jit_torch.1.7.1.pt"

cd exp
ln -sv cpu_jit_torch.1.7.1.pt cpu_jit.pt
```

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```
cd ..

for m in greedy_search modified_beam_search fast_beam_search; do
    sherpa-offline \
        --decoding-method=$m \
        --nn-model=./exp/cpu_jit.pt \
        --tokens=./data/lang_char/tokens.txt \
        ./test_wavs/T0055G0036S0002.wav \
        ./test_wavs/T0055G0036S0003.wav \
        ./test_wavs/T0055G0036S0004.wav
done
```

**icefall-asr-alimeeting-pruned-transducer-stateless7**

```
# This models is trained using alimeeting (https://www.openslr.org/119/)
#
# See https://github.com/k2-fsa/icefall/pull/751
#
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/desh2608/icefall-asr-alimeeting-pruned-transducer-stateless7
cd icefall-asr-alimeeting-pruned-transducer-stateless7

git lfs pull --include "exp/cpu_jit.pt"

for m in greedy_search modified_beam_search fast_beam_search; do
    sherpa-offline \
        --decoding-method=$m \
        --nn-model=./exp/cpu_jit.pt \
        --tokens=./data/lang_char/tokens.txt \
        ./test_wavs/165.wav \
        ./test_wavs/74.wav \
        ./test_wavs/209.wav
done
```

**Chinese + English****icefall\_asr\_tal-csasr\_pruned\_transducer\_stateless5**

```
# This models is trained using TAL_CSASR dataset from
# https://ai.100tal.com/dataset
# where each utterance contains both English and Chinese.
#
# See https://github.com/k2-fsa/icefall/pull/428
#
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/luomingshuang/icefall\_asr\_tal-csasr\_pruned\_transducer\_stateless5
cd icefall_asr_tal-csasr_pruned_transducer_stateless5
git lfs pull --include "exp/cpu_jit.pt"
```

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```
for m in greedy_search modified_beam_search fast_beam_search; do
    sherpa-offline \
        --decoding-method=$m \
        --nn-model=./exp/cpu_jit.pt \
        --tokens=./data/lang_char/tokens.txt \
        ./test_wavs/210_36476_210_8341_1_1533271973_7057520_132.wav \
        ./test_wavs/210_36476_210_8341_1_1533271973_7057520_138.wav \
        ./test_wavs/210_36476_210_8341_1_1533271973_7057520_145.wav \
        ./test_wavs/210_36476_210_8341_1_1533271973_7057520_148.wav
done
```

## Tibetan

icefall-asr-xbmu-amdo31-pruned-transducer-stateless7-2022-12-02

```

# This model is trained using the XBMU-AMDO31 corpus
#
# See https://github.com/k2-fsa/icefall/pull/706
#
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/syzym/icefall-asr-xbmu-amdo31-
˓→pruned-transducer-stateless7-2022-12-02
cd icefall-asr-xbmu-amdo31-pruned-transducer-stateless7-2022-12-02
git lfs pull --include "exp/cpu_jit.pt"
git lfs pull --include "data/lang_bpe_500/LG.pt"

for m in greedy_search modified_beam_search fast_beam_search; do
  sherpa-offline \
    --decoding-method=$m \
    --nn-model=./exp/cpu_jit.pt \
    --tokens=./data/lang_bpe_500/tokens.txt \
    ./test_wavs/a_0_cacm-A70_31116.wav \
    ./test_wavs/a_0_cacm-A70_31117.wav \
    ./test_wavs/a_0_cacm-A70_31118.wav
done

sherpa-offline \
  --decoding-method=fast_beam_search \
  --nn-model=./exp/cpu_jit.pt \
  --lg=./data/lang_bpe_500/LG.pt \
  --tokens=./data/lang_bpe_500/tokens.txt \
  ./test_wavs/a_0_cacm-A70_31116.wav \
  ./test_wavs/a_0_cacm-A70_31117.wav \
  ./test_wavs/a_0_cacm-A70_31118.wav

```

### icefall-asr-xbmu-amdo31-pruned-transducer-stateless5-2022-11-29

```

# This model is trained using the XBMU-AMDO31 corpus
#
# See https://github.com/k2-fsa/icefall/pull/706
#
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/syzym/icefall-asr-xbmu-amdo31-
˓→pruned-transducer-stateless5-2022-11-29
cd icefall-asr-xbmu-amdo31-pruned-transducer-stateless5-2022-11-29
git lfs pull --include "data/lang_bpe_500/LG.pt"
git lfs pull --include "data/lang_bpe_500/tokens.txt"
git lfs pull --include "exp/cpu_jit-epoch-28-avg-23-torch-1.10.0.pt"
git lfs pull --include "test_wavs/a_0_cacm-A70_31116.wav"
git lfs pull --include "test_wavs/a_0_cacm-A70_31117.wav"
git lfs pull --include "test_wavs/a_0_cacm-A70_31118.wav"

cd exp
rm cpu_jit.pt
ln -sv cpu_jit-epoch-28-avg-23-torch-1.10.0.pt cpu_jit.pt
cd ..

for m in greedy_search modified_beam_search fast_beam_search; do
  sherpa-offline \
    --decoding-method=$m \
    --nn-model=./exp/cpu_jit.pt \
    --tokens=./data/lang_bpe_500/tokens.txt \
    ./test_wavs/a_0_cacm-A70_31116.wav \
    ./test_wavs/a_0_cacm-A70_31117.wav \
    ./test_wavs/a_0_cacm-A70_31118.wav
done

sherpa-offline \
  --decoding-method=fast_beam_search \
  --nn-model=./exp/cpu_jit.pt \
  --lg=./data/lang_bpe_500/LG.pt \
  --tokens=./data/lang_bpe_500/tokens.txt \
  ./test_wavs/a_0_cacm-A70_31116.wav \
  ./test_wavs/a_0_cacm-A70_31117.wav \
  ./test_wavs/a_0_cacm-A70_31118.wav

```

### 6.2.3 Online transducer models

---

**Hint:** We use the binary `sherpa-online` below for demonstration. You can replace `sherpa-online` with `sherpa-online-websocket-server` and `sherpa-online-microphone`.

---



---

**Hint:** At present, only streaming transducer models from `icefall` are supported.

---

## icefall

This sections lists models trained using [icefall](#).

## English

icefall-asr-librispeech-streaming-zipformer-2023-05-17

icefall-asr-librispeech-pruned-transducer-stateless7-streaming-2022-12-29

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```
git lfs pull --include "exp/cpu_jit.pt"
git lfs pull --include "data/lang_bpe_500/LG.pt"

for m in greedy_search modified_beam_search fast_beam_search; do
    sherpa-online \
        --decoding-method=$m \
        --nn-model=./exp/cpu_jit.pt \
        --tokens=./data/lang_bpe_500/tokens.txt \
        ./test_wavs/1089-134686-0001.wav \
        ./test_wavs/1221-135766-0001.wav \
        ./test_wavs/1221-135766-0002.wav
done

# For fast_beam_search with LG
sherpa-online \
    --decoding-method=fast_beam_search \
    --nn-model=./exp/cpu_jit.pt \
    --lg=./data/lang_bpe_500/LG.pt \
    --tokens=./data/lang_bpe_500/tokens.txt \
    ./test_wavs/1089-134686-0001.wav \
    ./test_wavs/1221-135766-0001.wav \
    ./test_wavs/1221-135766-0002.wav
```

icefall-asr-librispeech-conv-emformer-transducer-stateless2-2022-07-05

```

# This model is trained using LibriSpeech with ConvEmformer transducer
#
# See https://github.com/k2-fsa/icefall/pull/440
#
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/Zengwei/icefall-asr-librispeech-
˓→conv-emformer-transducer-stateless2-2022-07-05
cd icefall-asr-librispeech-conv-emformer-transducer-stateless2-2022-07-05

git lfs pull --include "exp/cpu-jit-epoch-30-avg-10-torch-1.10.0.pt"
git lfs pull --include "data/lang_bpe_500/LG.pt"
cd exp
ln -sv cpu-jit-epoch-30-avg-10-torch-1.10.0.pt cpu_jit.pt
cd ..

for m in greedy_search modified_beam_search fast_beam_search; do
sherpa-online \
  --decoding-method=$m \
  --nn-model=./exp/cpu_jit.pt \
  --tokens=./data/lang_bpe_500/tokens.txt \
  ./test_wavs/1089-134686-0001.wav \
  ./test_wavs/1221-135766-0001.wav \
  ./test_wavs/1221-135766-0002.wav
done

# For fast_beam_search with LG

```

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```
./build/bin/sherpa-online \
--decoding-method=fast_beam_search \
--nn-model=./exp/cpu_jit.pt \
--lg=./data/lang_bpe_500/LG.pt \
--tokens=./data/lang_bpe_500/tokens.txt \
./test_wavs/1089-134686-0001.wav \
./test_wavs/1221-135766-0001.wav \
./test_wavs/1221-135766-0002.wav
```

**icefall-asr-librispeech-lstm-transducer-stateless2-2022-09-03**

```
# This model is trained using LibriSpeech with LSTM transducer
#
# See https://github.com/k2-fsa/icefall/pull/558
#
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/csukuangfj/icefall-asr-
↳ librispeech-lstm-transducer-stateless2-2022-09-03
cd icefall-asr-librispeech-lstm-transducer-stateless2-2022-09-03

git lfs pull --include "exp/encoder_jit_trace-iter-468000-avg-16.pt"
git lfs pull --include "exp/decoder_jit_trace-iter-468000-avg-16.pt"
git lfs pull --include "exp/joiner_jit_trace-iter-468000-avg-16.pt"
git lfs pull --include "data/lang_bpe_500/LG.pt"

cd exp
ln -sv encoder_jit_trace-iter-468000-avg-16.pt encoder_jit_trace.pt
ln -sv decoder_jit_trace-iter-468000-avg-16.pt decoder_jit_trace.pt
ln -sv joiner_jit_trace-iter-468000-avg-16.pt joiner_jit_trace.pt
cd ..

for m in greedy_search modified_beam_search fast_beam_search; do
  sherpa-online \
    --decoding-method=$m \
    --encoder-model=./exp/encoder_jit_trace.pt \
    --decoder-model=./exp/decoder_jit_trace.pt \
    --joiner-model=./exp/joiner_jit_trace.pt \
    --tokens=./data/lang_bpe_500/tokens.txt \
    ./test_wavs/1089-134686-0001.wav \
    ./test_wavs/1221-135766-0001.wav \
    ./test_wavs/1221-135766-0002.wav
done

# For fast_beam_search with LG
sherpa-online \
  --decoding-method=fast_beam_search \
  --encoder-model=./exp/encoder_jit_trace.pt \
  --decoder-model=./exp/decoder_jit_trace.pt \
  --joiner-model=./exp/joiner_jit_trace.pt \
  --lg=./data/lang_bpe_500/LG.pt
```

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```
--tokens=./data/lang_bpe_500/tokens.txt \
./test_wavs/1089-134686-0001.wav \
./test_wavs/1221-135766-0001.wav \
./test_wavs/1221-135766-0002.wav
```

### icefall-asr-librispeech-pruned-stateless-emformer-rnnt2-2022-06-01

```
# This model is trained using LibriSpeech with Emformer transducer
#
# See https://github.com/k2-fsa/icefall/pull/390
#
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/csukuangfj/icefall-asr-
→librispeech-pruned-stateless-emformer-rnnt2-2022-06-01
cd icefall-asr-librispeech-pruned-stateless-emformer-rnnt2-2022-06-01

git lfs pull --include "exp/cpu_jit-epoch-39-avg-6-use-averaged-model-1.pt"
git lfs pull --include "data/lang_bpe_500/LG.pt"
cd exp
ln -sv cpu_jit-epoch-39-avg-6-use-averaged-model-1.pt cpu_jit.pt
cd ..

for m in greedy_search modified_beam_search fast_beam_search; do
    sherpa-online \
        --decoding-method=$m \
        --nn-model=./exp/cpu_jit.pt \
        --tokens=./data/lang_bpe_500/tokens.txt \
        ./test_wavs/1089-134686-0001.wav \
        ./test_wavs/1221-135766-0001.wav \
        ./test_wavs/1221-135766-0002.wav
done

# For fast_beam_search with LG

sherpa-online \
    --decoding-method=fast_beam_search \
    --nn-model=./exp/cpu_jit.pt \
    --lg=./data/lang_bpe_500/LG.pt \
    --tokens=./data/lang_bpe_500/tokens.txt \
    ./test_wavs/1089-134686-0001.wav \
    ./test_wavs/1221-135766-0001.wav \
    ./test_wavs/1221-135766-0002.wav
```

icefall librispeech streaming pruned transducer stateless4 20220625

## Chinese

icefall asr wenetspeech pruned transducer stateless5 streaming

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```

git lfs pull --include "data/lang_char/LG.pt"
cd exp
ln -sv cpu_jit_epoch_7_avg_1_torch.1.7.1.pt cpu_jit.pt
cd ..

for m in greedy_search modified_beam_search fast_beam_search; do
    sherpa-online \
        --decoding-method=$m \
        --nn-model=./exp/cpu_jit.pt \
        --tokens=./data/lang_char/tokens.txt \
        ./test_wavs/DEV_T000000000000.wav \
        ./test_wavs/DEV_T000000000001.wav \
        ./test_wavs/DEV_T000000000002.wav
done

# For fast_beam_search with LG

sherpa-online \
    --decoding-method=fast_beam_search \
    --nn-model=./exp/cpu_jit.pt \
    --lg=./data/lang_char/LG.pt \
    --tokens=./data/lang_char/tokens.txt \
    ./test_wavs/DEV_T000000000000.wav \
    ./test_wavs/DEV_T000000000001.wav \
    ./test_wavs/DEV_T000000000002.wav

```

### Chinese + English (all-in-one)

#### pfluo/k2fsa-zipformer-chinese-english-mixed

It is a streaming zipformer model

```

# This model supports both Chinese and English
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/pfluo/k2fsa-zipformer-chinese-
˓→english-mixed
cd k2fsa-zipformer-chinese-english-mixed
git lfs pull --include "exp/cpu_jit.pt"

for m in greedy_search modified_beam_search fast_beam_search; do
    sherpa-online \
        --decoding-method=$m \
        --nn-model=./exp/cpu_jit.pt \
        --tokens=./data/lang_char_bpe/tokens.txt \
        ./test_wavs/0.wav \
        ./test_wavs/1.wav \
        ./test_wavs/2.wav \
        ./test_wavs/3.wav \
        ./test_wavs/4.wav
done

```

## icefall-asr-conv-emformer-transducer-stateless2-zh

It is a ConvEmformer model

```
# This model supports both Chinese and English
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/ptrnnull/icefall-asr-conv-emformer-
→transducer-stateless2-zh
cd icefall-asr-conv-emformer-transducer-stateless2-zh
git lfs pull --include "exp/cpu_jit-epoch-11-avg-1.pt"
cd exp
ln -sv cpu_jit-epoch-11-avg-1.pt cpu_jit.pt
cd ..

for m in greedy_search modified_beam_search fast_beam_search; do
    sherpa-online \
        --decoding-method=$m \
        --nn-model=./exp/cpu_jit.pt \
        --tokens=./data/lang_char_bpe/tokens.txt \
        ./test_wavs/0.wav \
        ./test_wavs/1.wav \
        ./test_wavs/2.wav \
        ./test_wavs/3.wav \
        ./test_wavs/4.wav
done
```

## SHERPA-NCNN

---

**Hint:** During speech recognition, it does not need to access the Internet. Everything is processed locally on your device.

---

We support using `ncnn` to replace PyTorch for neural network computation. The code is put in a separate repository `sherpa-ncnn`

`sherpa-ncnn` is self-contained and everything can be compiled from source.

Please refer to <https://k2-fsa.github.io/icefall/model-export/export-ncnn.html> for how to export models to `ncnn` format.

In the following, we describe how to build `sherpa-ncnn` for Linux, macOS, Windows, embedded systems, Android, and iOS.

Also, we show how to use it for speech recognition with pre-trained models.

### 7.1 Tutorials

This page contains links to tutorials written by our users.

**Caution:** The tutorials are not necessarily written in English.

#### 7.1.1 (Chinese tutorials)

##### Sherpa-ncnn (Windows)

<https://e.notionhero.io/e1/p/588ea9b-8032e075123ccb7011201836b45870a/63208185bd064e87a24a1d306847db4b>.

..

**2024 AndroidSherpaNcnn**

<https://www.ciyundata.com/post/35836.html>

Android `sherpa-ncnn`.

**2024 Unitysherpa-ncnn**

<https://github.com/sssssilver/sherpa-ncnn-unity>

unity.

**2024-02-22RV1126sherpaTTS**

<https://it3q.com/article/217>.

`sherpa-ncnn rv1126`

---

**Note:** TTS, `sherpa-ncnn` ASR `sherpa-onnix` TTS

---

**2023-12-31 sherpa-ncnn**

<https://zhuanlan.zhihu.com/p/675428374>.

Ubuntu (x64) 4B

---

**Note:** 4B 32 64

---

**2023-04-26RV1126kaldi**

[https://blog.csdn.net/qq\\_28877125/article/details/130376397](https://blog.csdn.net/qq_28877125/article/details/130376397).

`sherpa-ncnn RV1126`

**2023-02-19 sherpa-ncnn**

<https://www.jianshu.com/p/3afbb0324faa>.

3B+ Windows

## 7.2 Installation

---

**Hint:** Please refer to [Python API](#) for its usage with Python.

---

In this section, we describe how to install `sherpa-ncnn` for the following platforms:

### 7.2.1 Installation videos

This section presents some videos about how to install and use `sherpa-ncnn`.

#### Window (64-bit)

The following video shows how to install and use `sherpa-ncnn` on 64-bit Windows.

Thanks to <https://space.bilibili.com/7990701> for his contribution.

**Caution:** It is in Chinese.

### 7.2.2 Linux

This page describes how to build `sherpa-ncnn` on Linux.

---

**Hint:** You can follow this section if you want to build `sherpa-ncnn` directly on your board.

---



---

**Hint:** For the Python API, please refer to [Python API](#).

---

All you need is to run:

x86/x86\_64

32-bit ARM

64-bit ARM

```
git clone https://github.com/k2-fsa/sherpa-ncnn
cd sherpa-ncnn
mkdir build
cd build
cmake -DCMAKE_BUILD_TYPE=Release ..
make -j6
```

```
git clone https://github.com/k2-fsa/sherpa-ncnn
cd sherpa-ncnn
mkdir build
cd build
cmake \
-DCMAKE_BUILD_TYPE=Release \
```

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```
-DCMAKE_C_FLAGS="-march=armv7-a -mfloating-abi=hard -mfpu=neon" \
-DCMAKE_CXX_FLAGS="-march=armv7-a -mfloating-abi=hard -mfpu=neon" \
..
make -j6
```

```
git clone https://github.com/k2-fsa/sherpa-ncnn
cd sherpa-ncnn
mkdir build
cd build
cmake \
-DCMAKE_BUILD_TYPE=Release \
-DCMAKE_C_FLAGS="-march=armv8-a" \
-DCMAKE_CXX_FLAGS="-march=armv8-a" \
..
make -j6
```

After building, you will find two executables inside the bin directory:

```
$ ls -lh bin/
total 13M
-rwxr-xr-x 1 kuangfangjun root 6.5M Dec 18 11:31 sherpa-ncnn
-rwxr-xr-x 1 kuangfangjun root 6.5M Dec 18 11:31 sherpa-ncnn-microphone
```

That's it!

Please read [Pre-trained models](#) for usages about the generated binaries.

Read below if you want to learn more.

You can strip the binaries by

```
$ strip bin/sherpa-ncnn
$ strip bin/sherpa-ncnn-microphone
```

After stripping, the file size of each binary is:

```
$ ls -lh bin/
total 12M
-rwxr-xr-x 1 kuangfangjun root 5.8M Dec 18 11:35 sherpa-ncnn
-rwxr-xr-x 1 kuangfangjun root 5.8M Dec 18 11:36 sherpa-ncnn-microphone
```

---

**Hint:** By default, all external dependencies are statically linked. That means, the generated binaries are self-contained.

You can use the following commands to check that and you will find they depend only on system libraries.

```
$ readelf -d bin/sherpa-ncnn
Dynamic section at offset 0x5c0650 contains 34 entries:
  Tag          Type           Name/Value
 0x0000000000000001 (NEEDED)  Shared library: [libgomp.so.1]
 0x0000000000000001 (NEEDED)  Shared library: [libpthread.so.0]
 0x0000000000000001 (NEEDED)  Shared library: [libstdc++.so.6]
 0x0000000000000001 (NEEDED)  Shared library: [libm.so.6]
```

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```

0x0000000000000001 (NEEDED) Shared library: [libmvec.so.1]
0x0000000000000001 (NEEDED) Shared library: [libgcc_s.so.1]
0x0000000000000001 (NEEDED) Shared library: [libc.so.6]
0x000000000000001d (RUNPATH) Library runpath: [$ORIGIN:]

$ readelf -d bin/sherpa-ncnn-microphone

Dynamic section at offset 0x5c45d0 contains 34 entries:
  Tag          Type           Name/Value
 0x0000000000000001 (NEEDED) Shared library: [libpthread.so.0]
 0x0000000000000001 (NEEDED) Shared library: [libgomp.so.1]
 0x0000000000000001 (NEEDED) Shared library: [libstdc++.so.6]
 0x0000000000000001 (NEEDED) Shared library: [libm.so.6]
 0x0000000000000001 (NEEDED) Shared library: [libmvec.so.1]
 0x0000000000000001 (NEEDED) Shared library: [libgcc_s.so.1]
 0x0000000000000001 (NEEDED) Shared library: [libc.so.6]
 0x000000000000001d (RUNPATH) Library runpath: [$ORIGIN:]

```

Please create an issue at <https://github.com/k2-fsa/sherpa-ncnn/issues> if you have any problems.

### 7.2.3 macOS

This page describes how to build `sherpa-ncnn` on macOS.

**Hint:** For the Python API, please refer to [Python API](#).

All you need is to run:

```

git clone https://github.com/k2-fsa/sherpa-ncnn
cd sherpa-ncnn
mkdir build
cd build
cmake -DCMAKE_BUILD_TYPE=Release ..
make -j6

```

After building, you will find two executables inside the `bin` directory:

```

$ ls -lh bin/
total 24232
-rwxr-xr-x  1 fangjun  staff  5.9M Dec 18 12:39 sherpa-ncnn
-rwxr-xr-x  1 fangjun  staff  6.0M Dec 18 12:39 sherpa-ncnn-microphone

```

That's it!

Please read [Pre-trained models](#) for usages about the generated binaries.

Read below if you want to learn more.

You can strip the binaries by

```

$ strip bin/sherpa-ncnn
$ strip bin/sherpa-ncnn-microphone

```

After stripping, the file size of each binary is:

```
$ ls -lh bin/
total 23000
-rwxr-xr-x 1 fangjun staff 5.6M Dec 18 12:40 sherpa-ncnn
-rwxr-xr-x 1 fangjun staff 5.6M Dec 18 12:40 sherpa-ncnn-microphone
```

---

**Hint:** By default, all external dependencies are statically linked. That means, the generated binaries are self-contained.

You can use the following commands to check that and you will find they depend only on system libraries.

```
$ otool -L bin/sherpa-ncnn
bin/sherpa-ncnn:
    /usr/local/opt/libomp/lib/libomp.dylib (compatibility version 5.0.0, current version 5.0.0)
        /usr/lib/libc++.1.dylib (compatibility version 1.0.0, current version 902.1.0)
            /usr/lib/libSystem.B.dylib (compatibility version 1.0.0, current version 1281.100.1)

$ otool -L bin/sherpa-ncnn-microphone
bin/sherpa-ncnn-microphone:
    /System/Library/Frameworks/CoreAudio.framework/Versions/A/CoreAudio (compatibility version 1.0.0, current version 1.0.0)
        /System/Library/Frameworks/AudioToolbox.framework/Versions/A/AudioToolbox (compatibility version 1.0.0, current version 1000.0.0)
            /System/Library/Frameworks/AudioUnit.framework/Versions/A/AudioUnit (compatibility version 1.0.0, current version 1.0.0)
                /System/Library/Frameworks/CoreFoundation.framework/Versions/A/CoreFoundation (compatibility version 150.0.0, current version 1677.104.0)
                    /System/Library/Frameworks/CoreServices.framework/Versions/A/CoreServices (compatibility version 1.0.0, current version 1069.24.0)
                        /usr/lib/libSystem.B.dylib (compatibility version 1.0.0, current version 1281.100.1)
                            /usr/local/opt/libomp/lib/libomp.dylib (compatibility version 5.0.0, current version 5.0.0)
                                /usr/lib/libc++.1.dylib (compatibility version 1.0.0, current version 902.1.0)
```

---

Please create an issue at <https://github.com/k2-fsa/sherpa-ncnn/issues> if you have any problems.

### 7.2.4 Windows

This page describes how to build `sherpa-ncnn` on Windows.

---

**Hint:** For the Python API, please refer to [Python API](#).

---

**Hint:** MinGW is known not to work. Please install Visual Studio before you continue.

## 64-bit Windows (x64)

All you need is to run:

```
git clone https://github.com/k2-fsa/sherpa-ncnn
cd sherpa-ncnn
mkdir build
cd build
cmake -DCMAKE_BUILD_TYPE=Release ..
cmake --build . --config Release -- -m:6
```

It will generate two executables inside ./bin/Release/:

- **sherpa-ncnn.exe**: For decoding a single wave file.
- **sherpa-ncnn-microphone.exe**: For real-time speech recognition from a microphone

That's it!

Please read *Pre-trained models* for usages about the generated binaries.

Please create an issue at <https://github.com/k2-fsa/sherpa-ncnn/issues> if you have any problems.

## 32-bit Windows (x86)

All you need is to run:

```
git clone https://github.com/k2-fsa/sherpa-ncnn
cd sherpa-ncnn
mkdir build
cd build

# Please select one toolset among VS 2015, 2017, 2019, and 2022 below
# We use VS 2022 as an example.

# For Visual Studio 2015
# cmake -T v140,host=x64 -A Win32 -D CMAKE_BUILD_TYPE=Release ..

# For Visual Studio 2017
# cmake -T v141,host=x64 -A Win32 -D CMAKE_BUILD_TYPE=Release ..

# For Visual Studio 2019
# cmake -T v142,host=x64 -A Win32 -D CMAKE_BUILD_TYPE=Release ..

# For Visual Studio 2022
cmake -T v143,host=x64 -A Win32 -D CMAKE_BUILD_TYPE=Release ..

cmake --build . --config Release -- -m:6
```

It will generate two executables inside ./bin/Release/:

- **sherpa-ncnn.exe**: For decoding a single wave file.
- **sherpa-ncnn-microphone.exe**: For real-time speech recognition from a microphone

That's it!

Please read *Pre-trained models* for usages about the generated binaries.

Please create an issue at <https://github.com/k2-fsa/sherpa-ncnn/issues> if you have any problems.

### 7.2.5 Embedded Linux (arm)

This page describes how to build `sherpa-ncnn` for embedded Linux (arm, 32-bit) with cross-compiling on an x86 machine with Ubuntu OS.

**Caution:** If you want to build `sherpa-ncnn` directly on your board, please don't use this document. Refer to [Linux](#) instead.

**Caution:** If you want to build `sherpa-ncnn` directly on your board, please don't use this document. Refer to [Linux](#) instead.

**Caution:** If you want to build `sherpa-ncnn` directly on your board, please don't use this document. Refer to [Linux](#) instead.

---

**Hint:** This page is for cross-compiling.

---

#### Install toolchain

The first step is to install a toolchain for cross-compiling.

**Warning:** You can use any toolchain that is suitable for your platform. The toolchain we use below is just an example.

Visit <https://developer.arm.com/tools-and-software/open-source-software/developer-tools/gnu-toolchain/gnu-a/downloads/8-3-2019-03> to download the toolchain:

We are going to download `gcc-arm-8.3-2019.03-x86_64-arm-linux-gnueabihf.tar.xz`, which has been uploaded to <https://huggingface.co/csukuangfj/sherpa-ncnn-toolchains>.

Assume you want to install it in the folder `$HOME/software`:

```
mkdir -p $HOME/software
cd $HOME/software
wget https://huggingface.co/csukuangfj/sherpa-ncnn-toolchains/resolve/main/gcc-arm-8.3-
˓→2019.03-x86_64-arm-linux-gnueabihf.tar.xz
tar xvf gcc-arm-8.3-2019.03-x86_64-arm-linux-gnueabihf.tar.xz
```

Next, we need to set the following environment variable:

```
export PATH=$HOME/software/gcc-arm-8.3-2019.03-x86_64-arm-linux-gnueabihf/bin:$PATH
```

To check that we have installed the cross-compiling toolchain successfully, please run:

```
arm-linux-gnueabihf-gcc --version
```

which should print the following log:

```
arm-linux-gnueabihf-gcc (GNU Toolchain for the A-profile Architecture 8.3-2019.03 (arm-  
↪rel-8.3.0)) 8.3.0  
Copyright (C) 2018 Free Software Foundation, Inc.  
This is free software; see the source for copying conditions. There is NO  
warranty; not even for MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.
```

Congratulations! You have successfully installed a toolchain for cross-compiling `sherpa-ncnn`.

## Build `sherpa-ncnn`

Finally, let us build `sherpa-ncnn`.

```
git clone https://github.com/k2-fsa/sherpa-ncnn  
cd sherpa-ncnn  
./build-arm-linux-gnueabihf.sh
```

After building, you will get two binaries:

```
$ ls -lh build-arm-linux-gnueabihf/install/bin/  
  
total 6.6M  
-rwxr-xr-x 1 kuangfangjun root 2.2M Jan 14 21:46 sherpa-ncnn  
-rwxr-xr-x 1 kuangfangjun root 2.2M Jan 14 21:46 sherpa-ncnn-alsa
```

That's it!

---

### Hint:

- `sherpa-ncnn` is for decoding a single file
  - `sherpa-ncnn-alsa` is for real-time speech recognition by reading the microphone with [ALSA](#)
- 

**Caution:** We recommend that you use `sherpa-ncnn-alsa` on embedded systems such as Raspberry pi.

You need to provide a `device_name` when invoking `sherpa-ncnn-alsa`. We describe below how to find the device name for your microphone.

Run the following command:

```
arecord -l
```

to list all available microphones for recording. If it complains that `arecord: command not found`, please use `sudo apt-get install alsa-utils` to install it.

If the above command gives the following output:

```
**** List of CAPTURE Hardware Devices ****  
card 0: Audio [Axera Audio], device 0: 49ac000.i2s_mst-es8328-hifi-analog  
↪es8328-hifi-analog-0 []  
Subdevices: 1/1  
Subdevice #0: subdevice #0
```

In this case, I only have 1 microphone. It is card `0` and that card has only device `0`. To select card `0` and device `0` on that card, we need to pass `plughw:0,0` to `sherpa-ncnn-alsa`. (Note: It has the format `plughw:card_number,device_index`.)

For instance, you have to use

```
# Note: We use int8 models for encoder and joiner below.
./bin/sherpa-ncnn-alsa \
  ./sherpa-ncnn-conv-emformer-transducer-small-2023-01-09/tokens.txt \
  ./sherpa-ncnn-conv-emformer-transducer-small-2023-01-09/encoder_jit_trace-
  ↪ pnnx.ncnn.int8.param \
  ./sherpa-ncnn-conv-emformer-transducer-small-2023-01-09/encoder_jit_trace-
  ↪ pnnx.ncnn.int8.bin \
  ./sherpa-ncnn-conv-emformer-transducer-small-2023-01-09/decoder_jit_trace-
  ↪ pnnx.ncnn.param \
  ./sherpa-ncnn-conv-emformer-transducer-small-2023-01-09/decoder_jit_trace-
  ↪ pnnx.ncnn.bin \
  ./sherpa-ncnn-conv-emformer-transducer-small-2023-01-09/joiner_jit_trace-
  ↪ pnnx.ncnn.int8.param \
  ./sherpa-ncnn-conv-emformer-transducer-small-2023-01-09/joiner_jit_trace-
  ↪ pnnx.ncnn.int8.bin \
  "plughw:0,0"
```

Please change the card number and also the device index on the selected card accordingly in your own situation. Otherwise, you won't be able to record with your microphone.

Please read [Pre-trained models](#) for usages about the generated binaries.

Read below if you want to learn more.

**Hint:** By default, all external dependencies are statically linked. That means, the generated binaries are self-contained.

You can use the following commands to check that and you will find they depend only on system libraries.

```
$ readelf -d build-arm-linux-gnueabihf/install/bin/sherpa-ncnn

Dynamic section at offset 0x1c7ee8 contains 30 entries:
  Tag          Type                 Name/Value
  0x00000001 (NEEDED)           Shared library: [libstdc++.so.6]
  0x00000001 (NEEDED)           Shared library: [libm.so.6]
  0x00000001 (NEEDED)           Shared library: [libgcc_s.so.1]
  0x00000001 (NEEDED)           Shared library: [libpthread.so.0]
  0x00000001 (NEEDED)           Shared library: [libc.so.6]
  0x0000000f (RPATH)            Library rpath: [$ORIGIN]

$ readelf -d build-arm-linux-gnueabihf/install/bin/sherpa-ncnn-alsa

Dynamic section at offset 0x22ded8 contains 32 entries:
  Tag          Type                 Name/Value
  0x00000001 (NEEDED)           Shared library: [libasound.so.2]
  0x00000001 (NEEDED)           Shared library: [libgomp.so.1]
  0x00000001 (NEEDED)           Shared library: [libpthread.so.0]
  0x00000001 (NEEDED)           Shared library: [libstdc++.so.6]
  0x00000001 (NEEDED)           Shared library: [libm.so.6]
```

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0x00000001 (NEEDED)	Shared library: [libgcc_s.so.1]
0x00000001 (NEEDED)	Shared library: [libc.so.6]
0x0000000f (RPATH)	Library rpath: [\${ORIGIN}]

Please create an issue at <https://github.com/k2-fsa/sherpa-ncnn/issues> if you have any problems.

## 7.2.6 Embedded Linux (aarch64)

This page describes how to build `sherpa-ncnn` for embedded Linux (aarch64, 64-bit) with cross-compiling on an x86 machine with Ubuntu OS.

**Caution:** If you want to build `sherpa-ncnn` directly on your board, please don't use this document. Refer to [Linux](#) instead.

**Caution:** If you want to build `sherpa-ncnn` directly on your board, please don't use this document. Refer to [Linux](#) instead.

**Caution:** If you want to build `sherpa-ncnn` directly on your board, please don't use this document. Refer to [Linux](#) instead.

**Hint:** This page is for cross-compiling.

### Install toolchain

The first step is to install a toolchain for cross-compiling.

**Warning:** You can use any toolchain that is suitable for your platform. The toolchain we use below is just an example.

Visit <https://releases.linaro.org/components/toolchain/binaries/latest-7/aarch64-linux-gnu/> to download the toolchain.

We are going to download `gcc-linaro-7.5.0-2019.12-x86_64_aarch64-linux-gnu.tar.xz`, which has been uploaded to <https://huggingface.co/csukuangfj/sherpa-ncnn-toolchains>.

Assume you want to install it in the folder `$HOME/software`:

```
mkdir -p $HOME/software
cd $HOME/software
wget https://huggingface.co/csukuangfj/sherpa-ncnn-toolchains/resolve/main/gcc-linaro-7.
↪5.0-2019.12-x86_64_aarch64-linux-gnu.tar.xz

# For users from China
# huggingface,
```

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```
# wget https://hf-mirror.com/csukuangfj/sherpa-ncnn-toolchains/resolve/main/gcc-linaro-7.  
→5.0-2019.12-x86_64_aarch64-linux-gnu.tar.xz  
tar xvf gcc-linaro-7.5.0-2019.12-x86_64_aarch64-linux-gnu.tar.xz
```

Next, we need to set the following environment variable:

```
export PATH=$HOME/software/gcc-linaro-7.5.0-2019.12-x86_64_aarch64-linux-gnu/bin:$PATH
```

To check that we have installed the cross-compiling toolchain successfully, please run:

```
aarch64-linux-gnu-gcc --version
```

which should print the following log:

```
aarch64-linux-gnu-gcc (Linaro GCC 7.5-2019.12) 7.5.0  
Copyright (C) 2017 Free Software Foundation, Inc.  
This is free software; see the source for copying conditions. There is NO  
warranty; not even for MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.
```

Congratulations! You have successfully installed a toolchain for cross-compiling `sherpa-ncnn`.

### Build `sherpa-ncnn`

Finally, let us build `sherpa-ncnn`.

```
git clone https://github.com/k2-fsa/sherpa-ncnn  
cd sherpa-ncnn  
./build-aarch64-linux-gnu.sh
```

After building, you will get two binaries:

```
$ ls -lh build-aarch64-linux-gnu/install/bin/  
total 10M  
-rwxr-xr-x 1 kuangfangjun root 3.4M Jan 13 21:16 sherpa-ncnn  
-rwxr-xr-x 1 kuangfangjun root 3.4M Jan 13 21:16 sherpa-ncnn-alsa
```

That's it!

---

#### Hint:

- `sherpa-ncnn` is for decoding a single file
  - `sherpa-ncnn-alsa` is for real-time speech recognition by reading the microphone with `ALSA`
-

## sherpa-ncnn-alsa

**Caution:** We recommend that you use `sherpa-ncnn-alsa` on embedded systems such as Raspberry pi.

You need to provide a `device_name` when invoking `sherpa-ncnn-alsa`. We describe below how to find the device name for your microphone.

Run the following command:

```
arecord -l
```

to list all available microphones for recording. If it complains that `arecord: command not found`, please use `sudo apt-get install alsa-utils` to install it.

If the above command gives the following output:

```
**** List of CAPTURE Hardware Devices ****
card 3: UACDemoV10 [UACDemoV1.0], device 0: USB Audio [USB Audio]
  Subdevices: 1/1
  Subdevice #0: subdevice #0
```

In this case, I only have 1 microphone. It is `card 3` and that card has only `device 0`. To select `card 3` and `device 0` on that card, we need to pass `plughw:3,0` to `sherpa-ncnn-alsa`. (Note: It has the format `plughw:card_number,device_index`.)

For instance, you have to use

```
./bin/sherpa-ncnn-alsa \
  ./sherpa-ncnn-conv-emformer-transducer-small-2023-01-09/tokens.txt \
  ./sherpa-ncnn-conv-emformer-transducer-small-2023-01-09/encoder_jit_trace-
  ↪ pnnx.ncnn.param \
  ./sherpa-ncnn-conv-emformer-transducer-small-2023-01-09/encoder_jit_trace-
  ↪ pnnx.ncnn.bin \
  ./sherpa-ncnn-conv-emformer-transducer-small-2023-01-09/decoder_jit_trace-
  ↪ pnnx.ncnn.param \
  ./sherpa-ncnn-conv-emformer-transducer-small-2023-01-09/decoder_jit_trace-
  ↪ pnnx.ncnn.bin \
  ./sherpa-ncnn-conv-emformer-transducer-small-2023-01-09/joiner_jit_trace-
  ↪ pnnx.ncnn.param \
  ./sherpa-ncnn-conv-emformer-transducer-small-2023-01-09/joiner_jit_trace-
  ↪ pnnx.ncnn.bin \
  "plughw:3,0"
```

Please change the card number and also the device index on the selected card accordingly in your own situation. Otherwise, you won't be able to record with your microphone.

Please read [Pre-trained models](#) for usages about the generated binaries.

**Hint:** If you want to select a pre-trained model for Raspberry that can be run on real-time, we recommend you to use [marcoyang/sherpa-ncnn-conv-emformer-transducer-small-2023-01-09 \(English\)](#).

Read below if you want to learn more.

**Hint:** By default, all external dependencies are statically linked. That means, the generated binaries are self-contained.

You can use the following commands to check that and you will find they depend only on system libraries.

```
$ readelf -d build-aarch64-linux-gnu/install/bin/sherpa-ncnn

Dynamic section at offset 0x302a80 contains 30 entries:
  Tag      Type           Name/Value
 0x0000000000000001 (NEEDED)  Shared library: [libgomp.so.1]
 0x0000000000000001 (NEEDED)  Shared library: [libpthread.so.0]
 0x0000000000000001 (NEEDED)  Shared library: [libstdc++.so.6]
 0x0000000000000001 (NEEDED)  Shared library: [libm.so.6]
 0x0000000000000001 (NEEDED)  Shared library: [libgcc_s.so.1]
 0x0000000000000001 (NEEDED)  Shared library: [libc.so.6]
 0x000000000000000f (RPATH)   Library rpath: [$ORIGIN]

$ readelf -d build-aarch64-linux-gnu/install/bin/sherpa-ncnn-alsa

Dynamic section at offset 0x34ea48 contains 31 entries:
  Tag      Type           Name/Value
 0x0000000000000001 (NEEDED)  Shared library: [libasound.so.2]
 0x0000000000000001 (NEEDED)  Shared library: [libgomp.so.1]
 0x0000000000000001 (NEEDED)  Shared library: [libpthread.so.0]
 0x0000000000000001 (NEEDED)  Shared library: [libstdc++.so.6]
 0x0000000000000001 (NEEDED)  Shared library: [libm.so.6]
 0x0000000000000001 (NEEDED)  Shared library: [libgcc_s.so.1]
 0x0000000000000001 (NEEDED)  Shared library: [libc.so.6]
 0x000000000000000f (RPATH)   Library rpath: [$ORIGIN]
```

---

Please create an issue at <https://github.com/k2-fsa/sherpa-ncnn/issues> if you have any problems.

### 7.2.7 Embedded Linux (riscv64)

This page describes how to build `sherpa-ncnn` for embedded Linux (RISC-V, 64-bit) with cross-compiling on an x64 machine with Ubuntu OS.

---

**Hint:** We provide a colab notebook for you to try this section step by step.

If you are using Windows/macOS or you don't want to setup your local environment for cross-compiling, please use the above colab notebook.

---

#### Install toolchain

The first step is to install a toolchain for cross-compiling.

```
sudo apt-get install gcc-riscv64-linux-gnu
sudo apt-get install g++-riscv64-linux-gnu
```

To check that you have installed the toolchain successfully, please run

```
$ riscv64-linux-gnu-gcc --version
riscv64-linux-gnu-gcc (Ubuntu 7.5.0-3ubuntu1~18.04) 7.5.0
```

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 warranty; not even [for](#) MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.

```
$ riscv64-linux-gnu-g++ --version
riscv64-linux-gnu-g++ (Ubuntu 7.5.0-3ubuntu1~18.04) 7.5.0
Copyright (C) 2017 Free Software Foundation, Inc.
This is free software; see the source for copying conditions. There is NO
warranty; not even for MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.
```

## Build sherpa-ncnn

Next, let us build sherpa-ncnn.

```
git clone https://github.com/k2-fsa/sherpa-ncnn
cd sherpa-ncnn
./build-riscv64-linux-gnu.sh
```

After building, you will get two binaries:

```
$ ls -lh build-riscv64-linux-gnu/install/bin/
total 3.8M
-rwxr-xr-x 1 kuangfangjun root 1.9M May 23 22:12 sherpa-ncnn
-rwxr-xr-x 1 kuangfangjun root 1.9M May 23 22:12 sherpa-ncnn-alsa
```

That's it!

---

### Hint:

- sherpa-ncnn is for decoding a single file
  - sherpa-ncnn-alsa is for real-time speech recognition by reading the microphone with [ALSA](#)
- 

Please read [Pre-trained models](#) for usages about the generated binaries.

**Hint:** If you want to select a pre-trained model for [VisionFive 2](#) that can be run on real-time, we recommend you to use [csukuangfj/sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16 \(Bilingual, Chinese + English\)](#).

You can use the following command with the above model:

```
./sherpa-ncnn \
  ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/tokens.
  ↵txt \
  ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/
  ↵encoder_jit_trace-pnnx.ncnn.param \
  ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/
  ↵encoder_jit_trace-pnnx.ncnn.bin \
  ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/
  ↵decoder_jit_trace-pnnx.ncnn.param \
  ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/
  ↵decoder_jit_trace-pnnx.ncnn.bin \
```

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```
./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/joiner_
↳ jit_trace-pnnx.ncnn.param \
./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/joiner_
↳ jit_trace-pnnx.ncnn.bin \
./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/test_wavs/
↳ 5.wav \
4 \
greedy_search
```

---

Read below if you want to learn more.

**Hint:** By default, all external dependencies are statically linked. That means, the generated binaries are self-contained.

You can use the following commands to check that and you will find they depend only on system libraries.

```
$ readelf -d build-riscv64-linux-gnu/install/bin/sherpa-ncnn

Dynamic section at offset 0x1d6dc0 contains 31 entries:
  Tag          Type                 Name/Value
 0x0000000000000001 (NEEDED)      Shared library: [libgomp.so.1]
 0x0000000000000001 (NEEDED)      Shared library: [libpthread.so.0]
 0x0000000000000001 (NEEDED)      Shared library: [libstdc++.so.6]
 0x0000000000000001 (NEEDED)      Shared library: [libm.so.6]
 0x0000000000000001 (NEEDED)      Shared library: [libgcc_s.so.1]
 0x0000000000000001 (NEEDED)      Shared library: [libc.so.6]
 0x0000000000000001 (NEEDED)      Shared library: [ld-linux-riscv64-
↳ lp64d.so.1]
 0x0000000000000001d (RUNPATH)    Library runpath: [$ORIGIN]
 0x00000000000000020 (PREINIT_ARRAY) 0x1e18e0
 0x00000000000000021 (PREINIT_ARRAYSZ) 0x8

$ readelf -d build-riscv64-linux-gnu/install/bin/sherpa-ncnn-alsa

Dynamic section at offset 0x1d3db0 contains 32 entries:
  Tag          Type                 Name/Value
 0x0000000000000001 (NEEDED)      Shared library: [libasound.so.2]
 0x0000000000000001 (NEEDED)      Shared library: [libgomp.so.1]
 0x0000000000000001 (NEEDED)      Shared library: [libpthread.so.0]
 0x0000000000000001 (NEEDED)      Shared library: [libstdc++.so.6]
 0x0000000000000001 (NEEDED)      Shared library: [libm.so.6]
 0x0000000000000001 (NEEDED)      Shared library: [libgcc_s.so.1]
 0x0000000000000001 (NEEDED)      Shared library: [libc.so.6]
 0x0000000000000001 (NEEDED)      Shared library: [ld-linux-riscv64-
↳ lp64d.so.1]
 0x0000000000000001d (RUNPATH)    Library runpath: [$ORIGIN]
 0x00000000000000020 (PREINIT_ARRAY) 0x1de8c8
 0x00000000000000021 (PREINIT_ARRAYSZ) 0x8
```

---

Please create an issue at <https://github.com/k2-fsa/sherpa-ncnn/issues> if you have any problems.

If you want to build an Android app, please refer to *Android*. If you want to build an iOS app, please refer to *iOS*.

## 7.3 Python API

---

**Hint:** It is known to work for Python  $\geq 3.6$  on Linux, macOS, and Windows.

---

In this section, we describe

1. How to install the Python package `sherpa-ncnn`
2. How to use `sherpa-ncnn` Python API for real-time speech recognition with a microphone
3. How to use `sherpa-ncnn` Python API to recognize a single file

### 7.3.1 Installation

You can use 1 of the 4 methods below to install the Python package `sherpa-ncnn`:

#### Method 1

---

**Hint:** This method supports `x86_64`, `arm64` (e.g., Mac M1, 64-bit Raspberry Pi), and `arm32` (e.g., 32-bit Raspberry Pi).

---

```
pip install sherpa-ncnn
```

If you use Method 1, it will install pre-compiled libraries. The disadvantage is that it may not be optimized for your platform, while the advantage is that you don't need to install `cmake` or a C++ compiler.

For the following methods, you have to first install:

- `cmake`, which can be installed using `pip install cmake`
- A C++ compiler, e.g., GCC on Linux and macOS, Visual Studio on Windows

#### Method 2

```
git clone https://github.com/k2-fsa/sherpa-ncnn
cd sherpa-ncnn
python3 setup.py install
```

#### Method 3

```
pip install git+https://github.com/k2-fsa/sherpa-ncnn
```

#### Method 4 (For developers and embedded boards)

x86/x86\_64

32-bit ARM

64-bit ARM

```
git clone https://github.com/k2-fsa/sherpa-ncnn
cd sherpa-ncnn
mkdir build
cd build

cmake \
-D SHERPA_NCNN_ENABLE_PYTHON=ON \
-D SHERPA_NCNN_ENABLE_PORTAUDIO=OFF \
-D BUILD_SHARED_LIBS=ON \
..

make -j6

export PYTHONPATH=$PWD/lib:$PWD/../../sherpa-ncnn/python:$PYTHONPATH
```

```
git clone https://github.com/k2-fsa/sherpa-ncnn
cd sherpa-ncnn
mkdir build
cd build

cmake \
-D SHERPA_NCNN_ENABLE_PYTHON=ON \
-D SHERPA_NCNN_ENABLE_PORTAUDIO=OFF \
-D BUILD_SHARED_LIBS=ON \
-DCMAKE_C_FLAGS="-march=armv7-a -mfloating-abi=hard -mfpu=neon" \
-DCMAKE_CXX_FLAGS="-march=armv7-a -mfloating-abi=hard -mfpu=neon" \
..

make -j6

export PYTHONPATH=$PWD/lib:$PWD/../../sherpa-ncnn/python:$PYTHONPATH
```

```
git clone https://github.com/k2-fsa/sherpa-ncnn
cd sherpa-ncnn
mkdir build
cd build

cmake \
-D SHERPA_NCNN_ENABLE_PYTHON=ON \
-D SHERPA_NCNN_ENABLE_PORTAUDIO=OFF \
-D BUILD_SHARED_LIBS=ON \
-DCMAKE_C_FLAGS="-march=armv8-a" \
-DCMAKE_CXX_FLAGS="-march=armv8-a" \
..

make -j6
```

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```
export PYTHONPATH=$PWD/lib:$PWD/../../sherpa-ncnn/python:$PYTHONPATH
```

Let us check whether `sherpa-ncnn` was installed successfully:

```
python3 -c "import sherpa_ncnn; print(sherpa_ncnn.__file__)"
python3 -c "import _sherpa_ncnn; print(_sherpa_ncnn.__file__)"
```

They should print the location of `sherpa_ncnn` and `_sherpa_ncnn`.

**Hint:** If you use Method 1, Method 2, and Method 3, you can also use

```
python3 -c "import sherpa_ncnn; print(sherpa_ncnn.__version__)"
```

It should print the version of `sherpa-ncnn`, e.g., 1.1.

Next, we describe how to use `sherpa-ncnn` Python API for speech recognition:

- (1) Real-time speech recognition with a microphone
- (2) Recognize a file

### 7.3.2 Real-time recognition with a microphone

The following Python code shows how to use `sherpa-ncnn` Python API for real-time speech recognition with a microphone.

**Hint:** We use `sounddevice` for recording. Please run `pip install sounddevice` before you run the code below.

**Note:** You can download the code from

<https://github.com/k2-fsa/sherpa-ncnn/blob/master/python-api-examples/speech-recognition-from-microphone.py>

Listing 7.1: Real-time speech recognition with a microphone using `sherpa-ncnn` Python API

```
import sys

try:
    import sounddevice as sd
except ImportError as e:
    print("Please install sounddevice first. You can use")
    print()
    print("  pip install sounddevice")
    print()
    print("to install it")
    sys.exit(-1)
```

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```

import sherpa_ncnn

def create_recognizer():
    # Please replace the model files if needed.
    # See https://k2-fsa.github.io/sherpa/ncnn/pretrained_models/index.html
    # for download links.
    recognizer = sherpa_ncnn.Recognizer(
        tokens="./sherpa-ncnn-conv-emformer-transducer-2022-12-06/tokens.txt",
        encoder_param="./sherpa-ncnn-conv-emformer-transducer-2022-12-06/encoder_jit_"
        ↪trace-pnnx.ncnn.param",
        encoder_bin="./sherpa-ncnn-conv-emformer-transducer-2022-12-06/encoder_jit_trace-"
        ↪pnnx.ncnn.bin",
        decoder_param="./sherpa-ncnn-conv-emformer-transducer-2022-12-06/decoder_jit_"
        ↪trace-pnnx.ncnn.param",
        decoder_bin="./sherpa-ncnn-conv-emformer-transducer-2022-12-06/decoder_jit_trace-"
        ↪pnnx.ncnn.bin",
        joiner_param="./sherpa-ncnn-conv-emformer-transducer-2022-12-06/joiner_jit_trace-"
        ↪pnnx.ncnn.param",
        joiner_bin="./sherpa-ncnn-conv-emformer-transducer-2022-12-06/joiner_jit_trace-"
        ↪pnnx.ncnn.bin",
        num_threads=4,
    )
    return recognizer

def main():
    print("Started! Please speak")
    recognizer = create_recognizer()
    sample_rate = recognizer.sample_rate
    samples_per_read = int(0.1 * sample_rate) # 0.1 second = 100 ms
    last_result = ""
    with sd.InputStream(
        channels=1, dtype="float32", samplerate=sample_rate
    ) as s:
        while True:
            samples, _ = s.read(samples_per_read) # a blocking read
            samples = samples.reshape(-1)
            recognizer.accept_waveform(sample_rate, samples)
            result = recognizer.text
            if last_result != result:
                last_result = result
                print(result)

if __name__ == "__main__":
    devices = sd.query_devices()
    print(devices)
    default_input_device_idx = sd.default.device[0]
    print(f'Use default device: {devices[default_input_device_idx]["name"]}')

try:

```

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main()

**Code explanation:****1. Import the required packages**

```
try:
    import sounddevice as sd
except ImportError as e:
    print("Please install sounddevice first. You can use")
    print()
    print("  pip install sounddevice")
    print()
    print("to install it")
    sys.exit(-1)

import sherpa_ncnn
```

Two packages are imported:

- `sounddevice`, for recording with a microphone
- `sherpa-ncnn`, for real-time speech recognition

**2. Create the recognizer**

```
def create_recognizer():
    # Please replace the model files if needed.
    # See https://k2-fsa.github.io/sherpa/ncnn/pretrained\_models/index.html
    # for download links.
    recognizer = sherpa_ncnn.Recognizer(
        tokens=".sherpa-ncnn-conv-emformer-transducer-2022-12-06/tokens.txt",
        encoder_param=".sherpa-ncnn-conv-emformer-transducer-2022-12-06/encoder_jit_"
        ↴trace-pnnx.ncnn.param",
        encoder_bin=".sherpa-ncnn-conv-emformer-transducer-2022-12-06/encoder_jit_trace-"
        ↴pnnx.ncnn.bin",
        decoder_param=".sherpa-ncnn-conv-emformer-transducer-2022-12-06/decoder_jit_"
        ↴trace-pnnx.ncnn.param",
        decoder_bin=".sherpa-ncnn-conv-emformer-transducer-2022-12-06/decoder_jit_trace-"
        ↴pnnx.ncnn.bin",
        joiner_param=".sherpa-ncnn-conv-emformer-transducer-2022-12-06/joiner_jit_trace-"
        ↴pnnx.ncnn.param",
        joiner_bin=".sherpa-ncnn-conv-emformer-transducer-2022-12-06/joiner_jit_trace-"
        ↴pnnx.ncnn.bin",
        num_threads=4,
    )
    return recognizer

def main():
    print("Started! Please speak")
    recognizer = create_recognizer()
```

We use the model [csukuangfj/sherpa-ncnn-conv-emformer-transducer-2022-12-06](https://huggingface.co/csukuangfj/sherpa-ncnn-conv-emformer-transducer-2022-12-06) (*Chinese + English*) as an example, which is able to recognize both English and Chinese. You can replace it with other pre-trained models.

Please refer to [Pre-trained models](#) for more models.

---

**Hint:** The above example uses a `float16` encoder and joiner. You can also use the following code to switch to 8-bit (i.e., `int8`) quantized encoder and joiner.

```
recognizer = sherpa_ncnn.Recognizer(
    tokens="./sherpa-ncnn-conv-emformer-transducer-2022-12-06/tokens.txt",
    encoder_param="./sherpa-ncnn-conv-emformer-transducer-2022-12-06/encoder_
    ↴jit_trace-pnnx.ncnn.int8.param",
    encoder_bin="./sherpa-ncnn-conv-emformer-transducer-2022-12-06/encoder_jit_
    ↴trace-pnnx.ncnn.int8.bin",
    decoder_param="./sherpa-ncnn-conv-emformer-transducer-2022-12-06/decoder_
    ↴jit_trace-pnnx.ncnn.param",
    decoder_bin="./sherpa-ncnn-conv-emformer-transducer-2022-12-06/decoder_jit_
    ↴trace-pnnx.ncnn.bin",
    joiner_param="./sherpa-ncnn-conv-emformer-transducer-2022-12-06/joiner_jit_
    ↴trace-pnnx.ncnn.int8.param",
    joiner_bin="./sherpa-ncnn-conv-emformer-transducer-2022-12-06/joiner_jit_
    ↴trace-pnnx.ncnn.int8.bin",
    num_threads=4,
)
```

---

### 3. Start recording

```
sample_rate = recognizer.sample_rate
with sd.InputStream(
```

**Note that:**

- We set channel to 1 since the model supports only a single channel
- We use dtype `float32` so that the resulting audio samples are normalized to the range  $[-1, 1]$ .
- The sampling rate has to be `recognizer.sample_rate`, which is 16 kHz for all models at present.

### 4. Read audio samples from the microphone

```
samples_per_read = int(0.1 * sample_rate) # 0.1 second = 100 ms
) as s:
    while True:
```

**Note that:**

- It reads 100 ms of audio samples at a time. You can choose a larger value, e.g., 200 ms.
- No queue or callback is used. Instead, we use a blocking read here.
- The `samples` array is reshaped to a 1-D array

## 5. Invoke the recognizer with audio samples

```
samples, _ = s.read(samples_per_read) # a blocking read
```

Note that:

- `samples` has to be a 1-D tensor and should be normalized to the range [-1, 1].
- Upon accepting the audio samples, the recognizer starts the decoding automatically. There is no separate call for decoding.

## 6. Get the recognition result

```
samples = samples.reshape(-1)
recognizer.accept_waveform(sample_rate, samples)
result = recognizer.text
if last_result != result:
```

We use `recognizer.text` to get the recognition result. To avoid unnecessary output, we compare whether there is new result in `recognizer.text` and don't print to the console if there is nothing new recognized.

That's it!

## Summary

In summary, you need to:

1. Create the recognizer
2. Start recording
3. Read audio samples
4. Call `recognizer.accept_waveform(sample_rate, samples)`
5. Call `recognizer.text` to get the recognition result

The following is a YouTube video for demonstration.

<https://youtu.be/74SxVueROok>

**Hint:** If you don't have access to YouTube, please see the following video from bilibili:

---

**Note:** <https://github.com/k2-fsa/sherpa-ncnn/blob/master/python-api-examples/speech-recognition-from-microphone-with-endpoint-detection.py> supports endpoint detection.

Please see the following video for its usage:

---

### 7.3.3 Recognize a file

The following Python code shows how to use `sherpa-ncnn` Python API to recognize a wave file.

**Caution:** The sampling rate of the wave file has to be 16 kHz. Also, it should contain only a single channel and samples should be 16-bit (i.e., `int16`) encoded.

---

**Note:** You can download the code from

<https://github.com/k2-fsa/sherpa-ncnn/blob/master/python-api-examples/decode-file.py>

---

Listing 7.2: Decode a file with `sherpa-ncnn` Python API

```
import wave

import numpy as np
import sherpa_ncnn

def main():
    recognizer = sherpa_ncnn.Recognizer(
        tokens="./sherpa-ncnn-conv-emformer-transducer-2022-12-06/tokens.txt",
        encoder_param="./sherpa-ncnn-conv-emformer-transducer-2022-12-06/encoder_jit_
        ↵trace-pnnx.ncnn.param",
        encoder_bin="./sherpa-ncnn-conv-emformer-transducer-2022-12-06/encoder_jit_trace-
        ↵pnnx.ncnn.bin",
        decoder_param="./sherpa-ncnn-conv-emformer-transducer-2022-12-06/decoder_jit_
        ↵trace-pnnx.ncnn.param",
        decoder_bin="./sherpa-ncnn-conv-emformer-transducer-2022-12-06/decoder_jit_trace-
        ↵pnnx.ncnn.bin",
        joiner_param="./sherpa-ncnn-conv-emformer-transducer-2022-12-06/joiner_jit_trace-
        ↵pnnx.ncnn.param",
        joiner_bin="./sherpa-ncnn-conv-emformer-transducer-2022-12-06/joiner_jit_trace-
        ↵pnnx.ncnn.bin",
        num_threads=4,
    )

    filename = (
        "./sherpa-ncnn-conv-emformer-transducer-2022-12-06/test_wavs/1.wav"
    )
    with wave.open(filename) as f:
        assert f.getframerate() == recognizer.sample_rate, (
            f.getframerate(),
            recognizer.sample_rate,
        )
        assert f.getnchannels() == 1, f.getnchannels()
        assert f.getsampwidth() == 2, f.getsampwidth() # it is in bytes
        num_samples = f.getnframes()
        samples = f.readframes(num_samples)
        samples_int16 = np.frombuffer(samples, dtype=np.int16)
        samples_float32 = samples_int16.astype(np.float32)
```

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```

samples_float32 = samples_float32 / 32768

recognizer.accept_waveform(recognizer.sample_rate, samples_float32)

tail_paddings = np.zeros(
    int(recognizer.sample_rate * 0.5), dtype=np.float32
)
recognizer.accept_waveform(recognizer.sample_rate, tail_paddings)

recognizer.input_finished()

print(recognizer.text)

if __name__ == "__main__":
    main()

```

We use the model [csukuangji/sherpa-ncnn-conv-emformer-transducer-2022-12-06](https://huggingface.co/csukuangji/sherpa-ncnn-conv-emformer-transducer-2022-12-06) (*Chinese + English*) as an example, which is able to recognize both English and Chinese. You can replace it with other pre-trained models.

Please refer to [Pre-trained models](#) for more models.

**Hint:** The above example uses a float16 encoder and joiner. You can also use the following code to switch to 8-bit (i.e., int8) quantized encoder and joiner.

```

recognizer = sherpa_ncnn.Recognizer(
    tokens=".sherpa-ncnn-conv-emformer-transducer-2022-12-06/tokens.txt",
    encoder_param=".sherpa-ncnn-conv-emformer-transducer-2022-12-06/encoder_"
    ↴jit_trace-pnnx.ncnn.int8.param",
    encoder_bin=".sherpa-ncnn-conv-emformer-transducer-2022-12-06/encoder_jit_"
    ↴trace-pnnx.ncnn.int8.bin",
    decoder_param=".sherpa-ncnn-conv-emformer-transducer-2022-12-06/decoder_"
    ↴jit_trace-pnnx.ncnn.param",
    decoder_bin=".sherpa-ncnn-conv-emformer-transducer-2022-12-06/decoder_jit_"
    ↴trace-pnnx.ncnn.bin",
    joiner_param=".sherpa-ncnn-conv-emformer-transducer-2022-12-06/joiner_jit_"
    ↴trace-pnnx.ncnn.int8.param",
    joiner_bin=".sherpa-ncnn-conv-emformer-transducer-2022-12-06/joiner_jit_"
    ↴trace-pnnx.ncnn.int8.bin",
    num_threads=4,
)

```

## 7.4 WebAssembly

In this section, we describe how to build `sherpa-ncnn` for WebAssembly so that you can run real-time speech recognition with `WebAssembly`.

Please follow the steps below to build and run `sherpa-ncnn` for `WebAssembly`.

### 7.4.1 Install Emscripten

We need to compile the C/C++ files in `sherpa-ncnn` with the help of `emscripten`.

Please refer to [https://emscripten.org/docs/getting\\_started/downloads](https://emscripten.org/docs/getting_started/downloads) for detailed installation instructions.

The following is an example to show you how to install it on Linux/macOS.

```
git clone https://github.com/emscripten-core/emsdk.git
cd emsdk
git pull
./emsdk install latest
./emsdk activate latest
source ./emsdk_env.sh
```

To check that you have installed `emscripten` successfully, please run:

```
emcc -v
```

The above command should print something like below:

```
emcc (Emscripten gcc/clang-like replacement + linker emulating GNU ld) 3.1.48
  ↵(e967e20b4727956a30592165a3c1cde5c67fa0a8)
shared:INFO: (Emscripten: Running sanity checks)
(py38) fangjuns-MacBook-Pro:open-source fangjun$ emcc -v
emcc (Emscripten gcc/clang-like replacement + linker emulating GNU ld) 3.1.48
  ↵(e967e20b4727956a30592165a3c1cde5c67fa0a8)
clang version 18.0.0 (https://github.com/llvm/llvm-project
  ↵a54545ba6514802178cf7cf1c1dd9f7efbf3cde7)
Target: wasm32-unknown-emscripten
Thread model: posix
InstalledDir: /Users/fangjun/open-source/emsdk/upstream/bin
```

Congratulations! You have successfully installed `emscripten`.

### 7.4.2 Build

After installing `emscripten`, we can build `sherpa-ncnn` for `WebAssembly` now.

Please use the following command to build it:

```
git clone https://github.com/k2-fsa/sherpa-ncnn
cd sherpa-ncnn

cd wasm/assets
wget -q https://github.com/k2-fsa/sherpa-ncnn/releases/download/models/sherpa-ncnn-
  ↵streaming-zipformer-bilingual-zh-en-2023-02-13.tar.b2z
```

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```

tar xvf sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13.tar.bz2
mv -v sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13/*pnnx.ncnn.param .
mv -v sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13/*pnnx.ncnn.bin .
mv -v sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13/tokens.txt .
rm -rf sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13
rm -v sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13.tar.bz2
cd ../.

./build-wasm-simd.sh

```

**Hint:** You can visit <https://github.com/k2-fsa/sherpa-ncnn/releases/tag/models> to download a different model.

After building, you should see the following output:

```

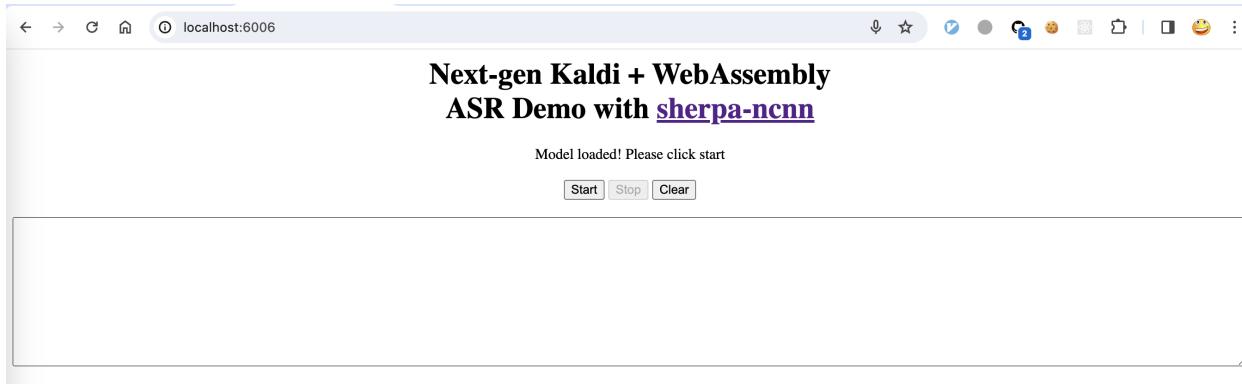
Install the project...
-- Install configuration: "Release"
-- Installing: /Users/fangjun/open-source/sherpa-ncnn/build-wasm-simd/install/lib/
  ↵libkaldi-native-fbank-core.a
-- Installing: /Users/fangjun/open-source/sherpa-ncnn/build-wasm-simd/install/lib/
  ↵libncnn.a
-- Installing: /Users/fangjun/open-source/sherpa-ncnn/build-wasm-simd/install./sherpa-
  ↵ncnn.pc
-- Installing: /Users/fangjun/open-source/sherpa-ncnn/build-wasm-simd/install/lib/
  ↵libsherpa-ncnn-core.a
-- Installing: /Users/fangjun/open-source/sherpa-ncnn/build-wasm-simd/install/lib/
  ↵libsherpa-ncnn-c-api.a
-- Installing: /Users/fangjun/open-source/sherpa-ncnn/build-wasm-simd/install/include/
  ↵sherpa-ncnn/c-api/c-api.h
-- Installing: /Users/fangjun/open-source/sherpa-ncnn/build-wasm-simd/install/bin/wasm/
  ↵sherpa-ncnn-wasm-main.js
-- Installing: /Users/fangjun/open-source/sherpa-ncnn/build-wasm-simd/install/bin/wasm/
  ↵sherpa-ncnn.js
-- Installing: /Users/fangjun/open-source/sherpa-ncnn/build-wasm-simd/install/bin/wasm/
  ↵app.js
-- Installing: /Users/fangjun/open-source/sherpa-ncnn/build-wasm-simd/install/bin/wasm/
  ↵index.html
-- Up-to-date: /Users/fangjun/open-source/sherpa-ncnn/build-wasm-simd/install/bin/wasm/
  ↵sherpa-ncnn-wasm-main.js
-- Installing: /Users/fangjun/open-source/sherpa-ncnn/build-wasm-simd/install/bin/wasm/
  ↵sherpa-ncnn-wasm-main.wasm
-- Installing: /Users/fangjun/open-source/sherpa-ncnn/build-wasm-simd/install/bin/wasm/
  ↵sherpa-ncnn-wasm-main.data
+ ls -lh install/bin/wasm
total 280152
-rw-r--r-- 1 fangjun staff 9.0K Feb 6 15:42 app.js
-rw-r--r-- 1 fangjun staff 936B Feb 6 15:42 index.html
-rw-r--r-- 1 fangjun staff 135M Feb 6 17:06 sherpa-ncnn-wasm-main.data
-rw-r--r-- 1 fangjun staff 79K Feb 6 17:06 sherpa-ncnn-wasm-main.js
-rw-r--r-- 1 fangjun staff 1.7M Feb 6 17:06 sherpa-ncnn-wasm-main.wasm
-rw-r--r-- 1 fangjun staff 6.9K Feb 6 15:42 sherpa-ncnn.js

```

Now you can use the following command to run it:

```
cd build-wasm-simd/install/bin/wasm/
python3 -m http.server 6006
```

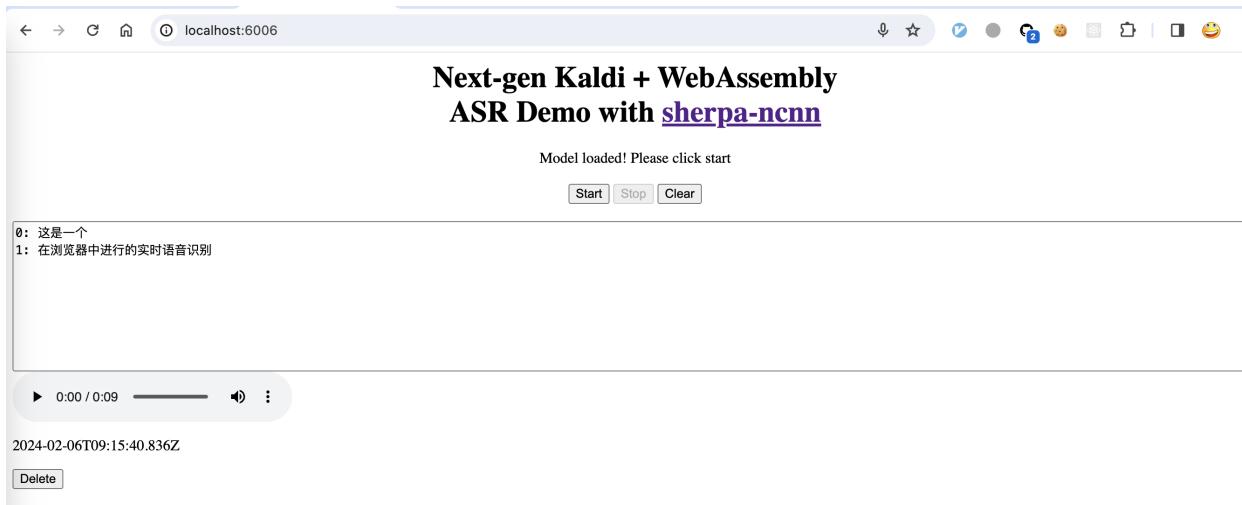
Start your browser and visit <http://localhost:6006>; you should see the following page:



Now click start and speak! You should see the recognition results in the text box.

**Warning:** We are using a bilingual model (Chinese + English) in the above example, which means you can only speak Chinese or English in this case.

A screenshot is given below:



Congratulations! You have successfully run real-time speech recognition with [WebAssembly](#) in your browser.

### 7.4.3 Use pre-built WebAssembly library

In this section, we describe how to use the pre-built WebAssembly library of sherpa-ncnn for real-time speech recognition.

**Note:** Note that the pre-built library used in this section uses a bilingual model (Chinese + English), which is from [csukuangfj/sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13](https://github.com/csukuangfj/sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13) (*Bilingual, Chinese + English*).

#### Download

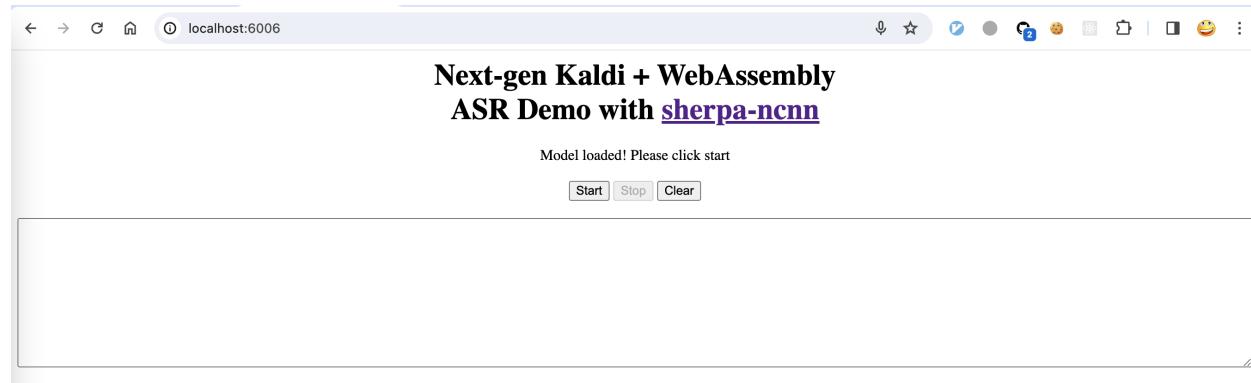
Please use the following command to download the pre-built library for version v2.1.7, which is the latest release as of 2024.02.06.

**Hint:** Please always use the latest release. You can visit <https://github.com/k2-fsa/sherpa-ncnn/releases> to find the latest release.

```
wget -q https://github.com/k2-fsa/sherpa-ncnn/releases/download/v2.1.7/sherpa-ncnn-wasm-
˓→simd-v2.1.7.tar.bz2
tar xvf sherpa-ncnn-wasm-simd-v2.1.7.tar.bz2
rm sherpa-ncnn-wasm-simd-v2.1.7.tar.bz2
cd sherpa-ncnn-wasm-simd-v2.1.7

python3 -m http.server 6006
```

Start your browser and visit <http://localhost:6006>; you should see the following page:



Now click start and speak! You should see the recognition results in the text box.

**Warning:** We are using a bilingual model (Chinese + English) in the above example, which means you can only speak Chinese or English in this case.

A screenshot is given below:

Congratulations! You have successfully run real-time speech recognition with WebAssembly in your browser.



#### 7.4.4 Huggingface Spaces (WebAssembly)

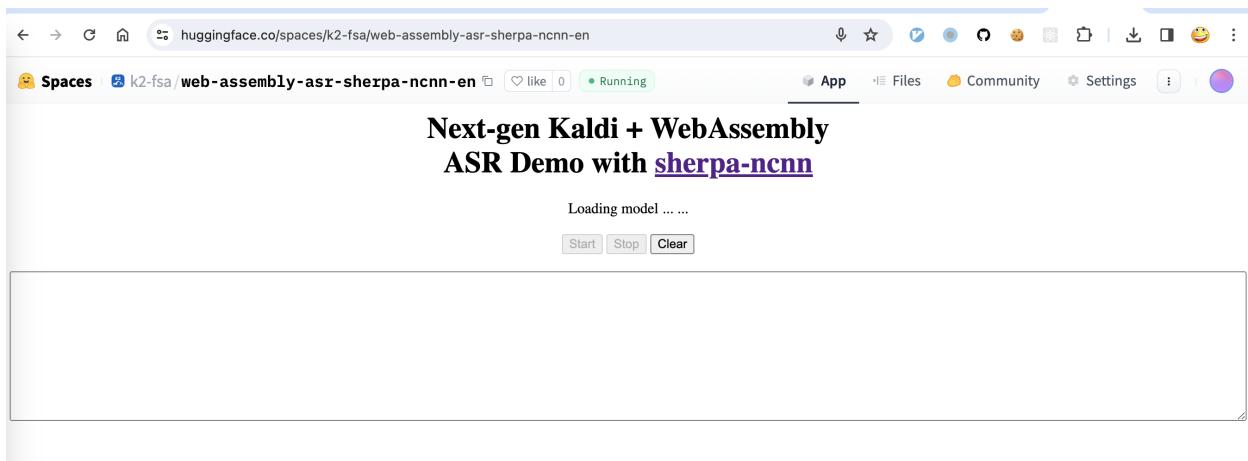
We provide two Huggingface spaces so that you can try real-time speech recognition with WebAssembly in your browser.

##### English only

<https://huggingface.co/spaces/k2-fsa/web-assembly-asr-sherpa-ncnn-en>

**Hint:** If you don't have access to Huggingface, please visit the following mirror:

<https://modelscope.cn/studios/k2-fsa/web-assembly-asr-sherpa-ncnn-en/summary>



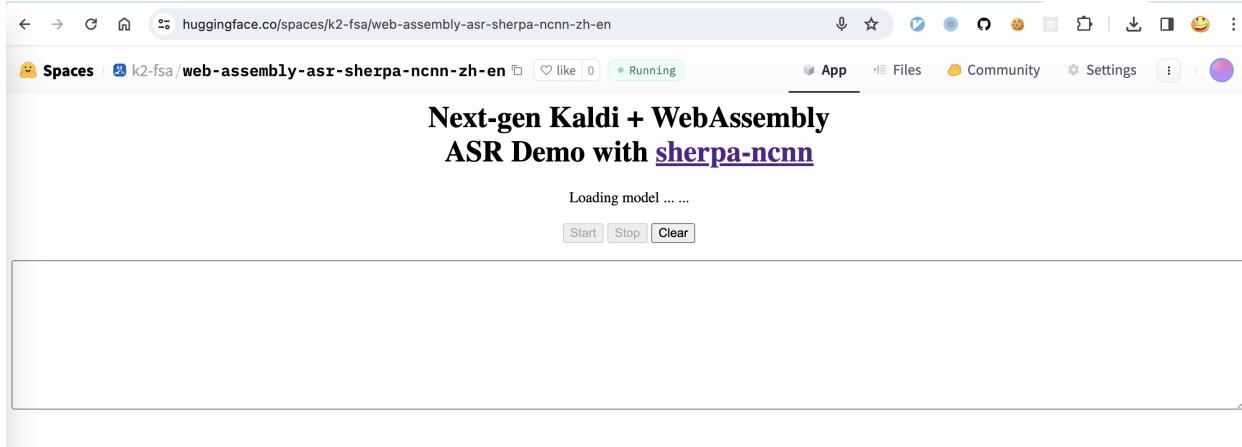
**Note:** The script for building this space can be found at <https://github.com/k2-fsa/sherpa-ncnn/blob/master/.github/workflows/wasm-simd-hf-space-en.yaml>

## Chinese + English

<https://huggingface.co/spaces/k2-fsa/web-assembly-asr-sherpa-ncnn-zh-en>

**Hint:** If you don't have access to Huggingface, please visit the following mirror:

<https://modelscope.cn/studios/k2-fsa/web-assembly-asr-sherpa-ncnn-zh-en/summary>



**Note:** The script for building this space can be found at <https://github.com/k2-fsa/sherpa-ncnn/blob/master/.github/workflows/wasm-simd-hf-space-zh-en.yaml>

## 7.5 C API

In this section, we describe how to use the C API of `sherpa-ncnn`.

Specifically, we will describe:

- How to generate required files
- How to use `pkg-config` with `sherpa-ncnn`

### 7.5.1 Generate required files

Before using the C API of `sherpa-ncnn`, we need to first build required libraries. You can choose either to build static libraries or shared libraries.

## Build shared libraries

Assume that we want to put library files and header files in the directory `/tmp/sherpa-ncnn/shared`:

```
git clone https://github.com/k2-fsa/sherpa-ncnn
cd sherpa-ncnn
mkdir build-shared
cd build-shared

cmake \
-DSHERPA_NCNN_ENABLE_C_API=ON \
-DCMAKE_BUILD_TYPE=Release \
-DBUILD_SHARED_LIBS=ON \
-DCMAKE_INSTALL_PREFIX=/tmp/sherpa-ncnn/shared \
..

make -j6
make install
```

You should find the following files inside `/tmp/sherpa-ncnn/shared`:

macOS

Linux

```
$ tree /tmp/sherpa-ncnn/shared/
/tmp/sherpa-ncnn/shared/
├── bin
│   └── sherpa-ncnn
│       └── sherpa-ncnn-microphone
├── include
│   └── sherpa-ncnn
│       └── c-api
│           └── c-api.h
└── lib
    ├── libkaldi-native-fbank-core.dylib
    ├── libncnn.dylib
    ├── libsherpa-ncnn-c-api.dylib
    └── libsherpa-ncnn-core.dylib
    sherpa-ncnn.pc

5 directories, 8 files
```

```
$ tree /tmp/sherpa-ncnn/shared/
/tmp/sherpa-ncnn/shared/
├── bin
│   └── sherpa-ncnn
│       └── sherpa-ncnn-microphone
├── include
│   └── sherpa-ncnn
│       └── c-api
│           └── c-api.h
└── lib
    └── libkaldi-native-fbank-core.so
```

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```

  └── libncnn.so
  └── libsherpa-ncnn-c-api.so
  └── libsherpa-ncnn-core.so
  └── sherpa-ncnn.pc

```

5 directories, 8 files

## Build static libraries

Assume that we want to put library files and header files in the directory `/tmp/sherpa-ncnn/static`:

```

git clone https://github.com/k2-fsa/sherpa-ncnn
cd sherpa-ncnn
mkdir build-static
cd build-static

cmake \
-DSHERPA_NCNN_ENABLE_C_API=ON \
-DCMAKE_BUILD_TYPE=Release \
-DBUILD_SHARED_LIBS=OFF \
-DCMAKE_INSTALL_PREFIX=/tmp/sherpa-ncnn/static \
..

make -j6
make install

```

You should find the following files in `/tmp/sherpa-ncnn/static`:

```

$ tree /tmp/sherpa-ncnn/static/
/tmp/sherpa-ncnn/static/
├── bin
│   └── sherpa-ncnn
│       └── sherpa-ncnn-microphone
├── include
│   └── sherpa-ncnn
│       └── c-api
│           └── c-api.h
└── lib
    ├── libkaldi-native-fbank-core.a
    ├── libncnn.a
    ├── libsherpa-ncnn-c-api.a
    └── libsherpa-ncnn-core.a
    └── sherpa-ncnn.pc

```

5 directories, 8 files

## 7.5.2 Build decode-file-c-api.c with generated files

To build the following file:

<https://github.com/k2-fsa/sherpa-ncnn/blob/master/c-api-examples/decode-file-c-api.c>

We can use:

static link

dynamic link

```
export PKG_CONFIG_PATH=/tmp/sherpa-ncnn/static:$PKG_CONFIG_PATH

cd ./c-api-examples
gcc -o decode-file-c-api $(pkg-config --cflags sherpa-ncnn) ./decode-file-c-api.c $(pkg-
config --libs sherpa-ncnn)
```

```
export PKG_CONFIG_PATH=/tmp/sherpa-ncnn/shared:$PKG_CONFIG_PATH

cd ./c-api-examples
gcc -o decode-file-c-api $(pkg-config --cflags sherpa-ncnn) ./decode-file-c-api.c $(pkg-
config --libs sherpa-ncnn)
```

## 7.6 Endpointing

We have three rules for endpoint detection. If any of them is activated, we assume an endpoint is detected.

---

**Note:** We borrow the implementation from

[https://kaldi-asr.org/doc/structkaldi\\_1\\_1OnlineEndpointRule.html](https://kaldi-asr.org/doc/structkaldi_1_1OnlineEndpointRule.html)

---

### 7.6.1 Rule 1

In Rule 1, we count the duration of trailing silence. If it is larger than a user specified value, Rule 1 is activated. The following is an example, which uses 2.4 seconds as the threshold.

Two cases are given:

- (1) In the first case, nothing has been decoded when the duration of trailing silence reaches 2.4 seconds.
- (2) In the second case, we first decode something before the duration of trailing silence reaches 2.4 seconds.

In both cases, Rule 1 is activated.

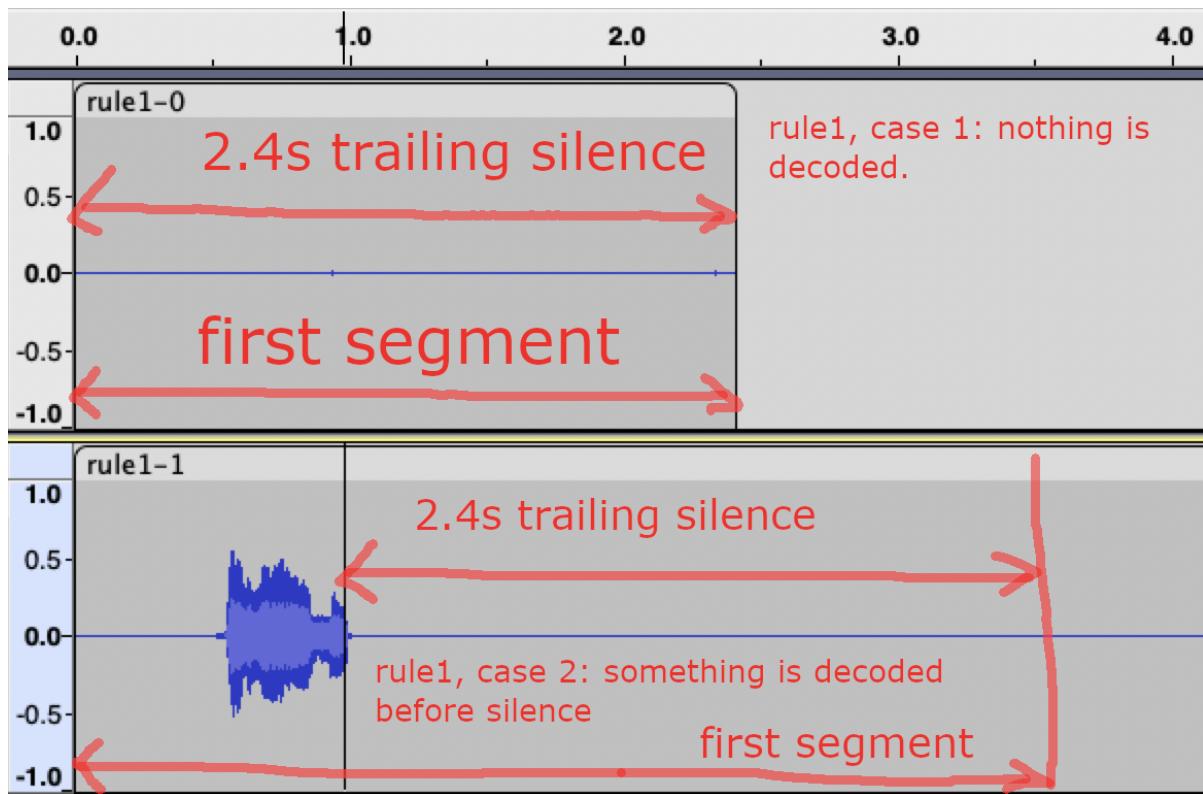
---

**Hint:** In the Python API, you can specify `rule1_min_trailing_silence` while constructing an instance of `sherpa_ncnn.Recognizer`.

---

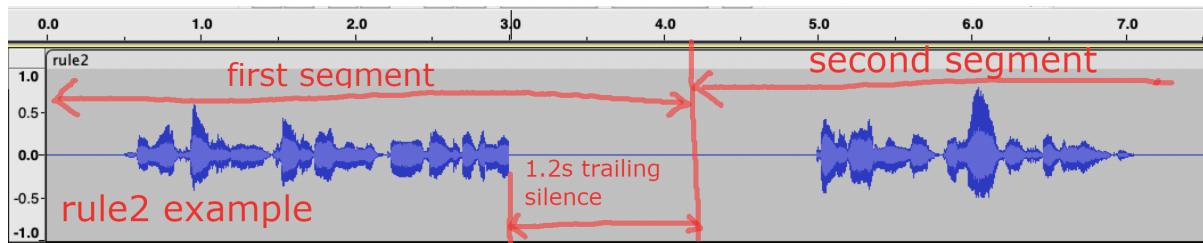
In the C++ API, you can specify `rule1.min_trailing_silence` when creating `EndpointConfig`.

---



## 7.6.2 Rule 2

In Rule 2, we require that it has to first decode something before we count the trailing silence. In the following example, after decoding something, Rule 2 is activated when the duration of trailing silence is larger than the user specified value 1.2 seconds.

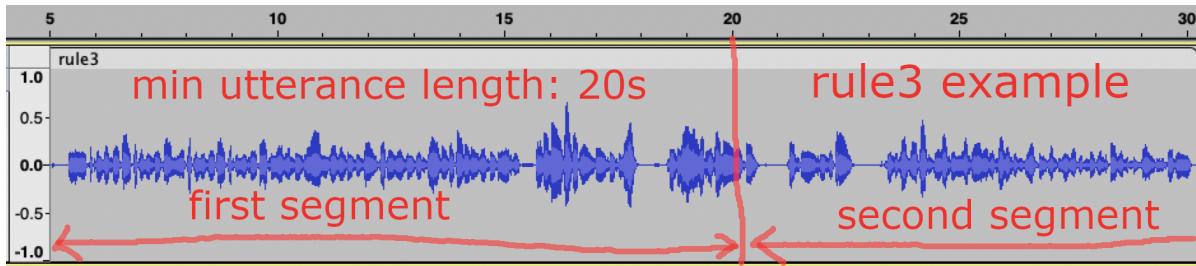


**Hint:** In the Python API, you can specify `rule2_min_trailing_silence` while constructing an instance of `sherpa_ncnn.Recognizer`.

In the C++ API, you can specify `rule2.min_trailing_silence` when creating `EndpointConfig`.

### 7.6.3 Rule 3

Rule 3 is activated when the utterance length in seconds is larger than a given value. In the following example, Rule 3 is activated after the first segment reaches a given value, which is 20 seconds in this case.



---

**Hint:** In the Python API, you can specify `rule3_min_utterance_length` while constructing an instance of `sherpa_ncnn.Recognizer`.

In the C++ API, you can specify `rule3.min_utterance_length` when creating `EndpointConfig`.

---

**Note:** If you want to deactivate this rule, please provide a very large value for `rule3_min_utterance_length` or `rule3.min_utterance_length`.

---

### 7.6.4 Demo

#### Multilingual (Chinese + English)

The following video demonstrates using the Python API of `sherpa-ncnn` for real-time speech recognition with end-pointing.

---

**Hint:** The code is available at

<https://github.com/k2-fsa/sherpa-ncnn/blob/master/python-api-examples/speech-recognition-from-microphone-with-endpoint-detection.py>

---

### 7.6.5 FAQs

#### How to compute duration of silence

For each frame to be decoded, we can output either a blank or a non-blank token. We record the number of contiguous blanks that has been decoded so far. In the current default setting, each frame is 10 ms. Thus, we can get the duration of trailing silence by counting the number of contiguous trailing blanks.

---

**Note:** If a model uses a subsampling factor of 4, the time resolution becomes  $10 * 4 = 40$  ms.

---

## 7.7 Android

In this section, we describe how to build an Android app for **real-time** speech recognition with `sherpa-ncnn`. We also provide real-time speech recognition video demos.

---

**Hint:** During speech recognition, it does not need to access the Internet. Everything is processed locally on your phone.

---

### 7.7.1 Video demos

In this page, we list some videos about using `sherpa-ncnn` for real-time speech recognition on Android.

---

**Hint:** You can find pre-built APK packages used by the following videos at:

<https://huggingface.co/csukuangfj/sherpa-ncnn-apk/tree/main>

- CPU versions require Android  $\geq 5.0$
  - GPU versions with Vulkan require Android  $\geq 7.0$
- 

---

**Note:** You can also find the latest APK for each release at

<https://github.com/k2-fsa/sherpa-ncnn/releases>

---

**Video 1: Chinese**

**Video 2: Chinese + English**

**Video 3: Chinese with background noise**

**Video 4: Chinese poem with background music**

### 7.7.2 Build `sherpa-ncnn` for Android

#### Install Android Studio

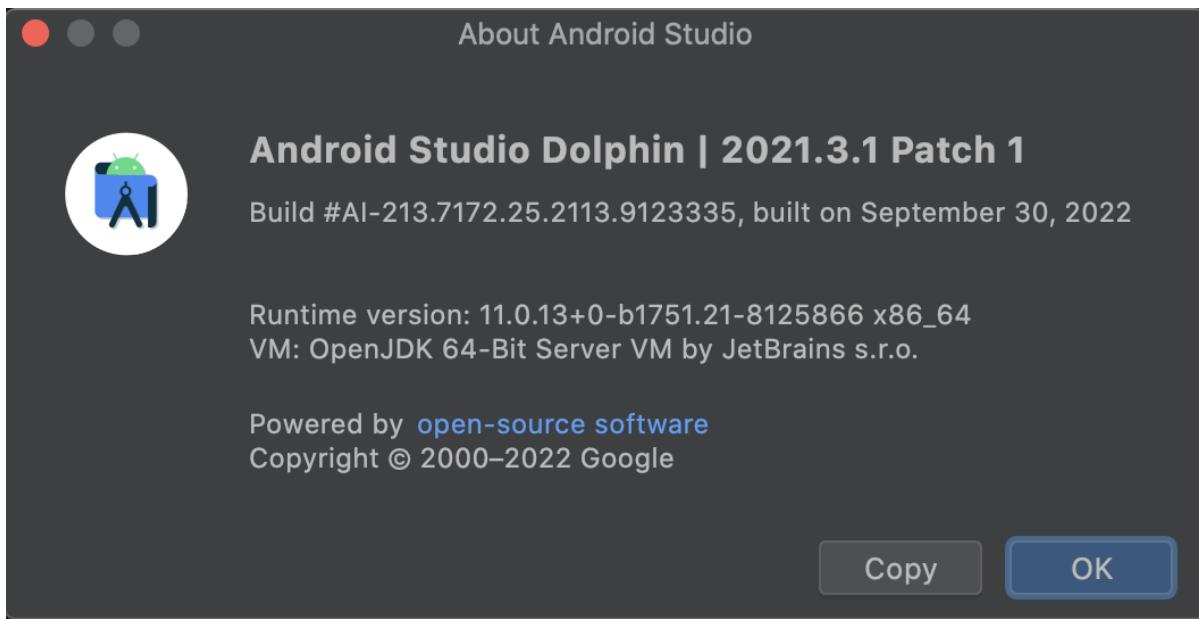
The first step is to download and install Android Studio.

Please refer to <https://developer.android.com/studio> for how to install Android Studio.

---

**Hint:** Any recent version of Android Studio should work fine. Also, you can use the default settings of Android Studio during installation.

For reference, we post the version we are using below:



## Download sherpa-ncnn

Next, download the source code of sherpa-ncnn:

```
git clone https://github.com/k2-fsa/sherpa-ncnn
```

## Install NDK

Step 1, start Android Studio.

Step 2, Open `sherpa-ncnn/android/SherpaNcnn`.

Step 3, Select Tools -> SDK Manager.

Step 4, Install NDK.

In the following, we assume Android SDK location was set to `/Users/fangjun/software/my-android`. You can change it accordingly below.

After installing NDK, you can find it in

```
/Users/fangjun/software/my-android/ndk/22.1.7171670
```

**Warning:** If you selected a different version of NDK, please replace `22.1.7171670` accordingly.

Next, let us set the environment variable `ANDROID_NDK` for later use.

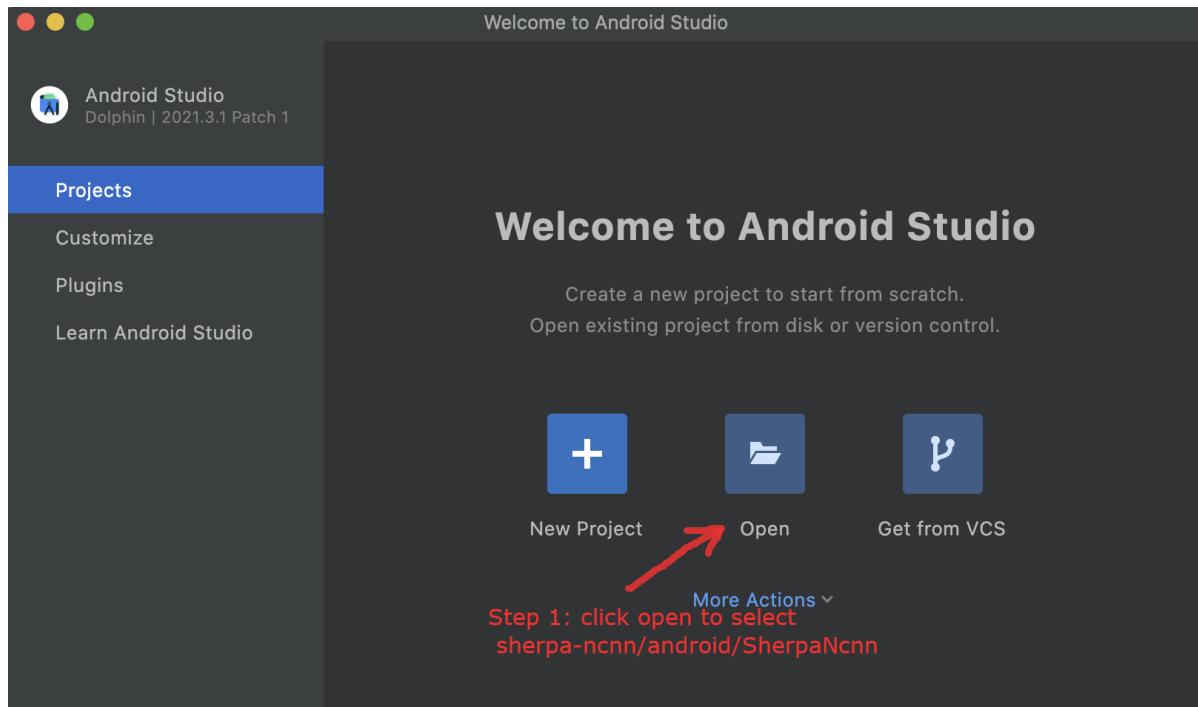


Fig. 7.1: Step 1: Click Open to select sherpa-ncnn/android/SherpaNcnn

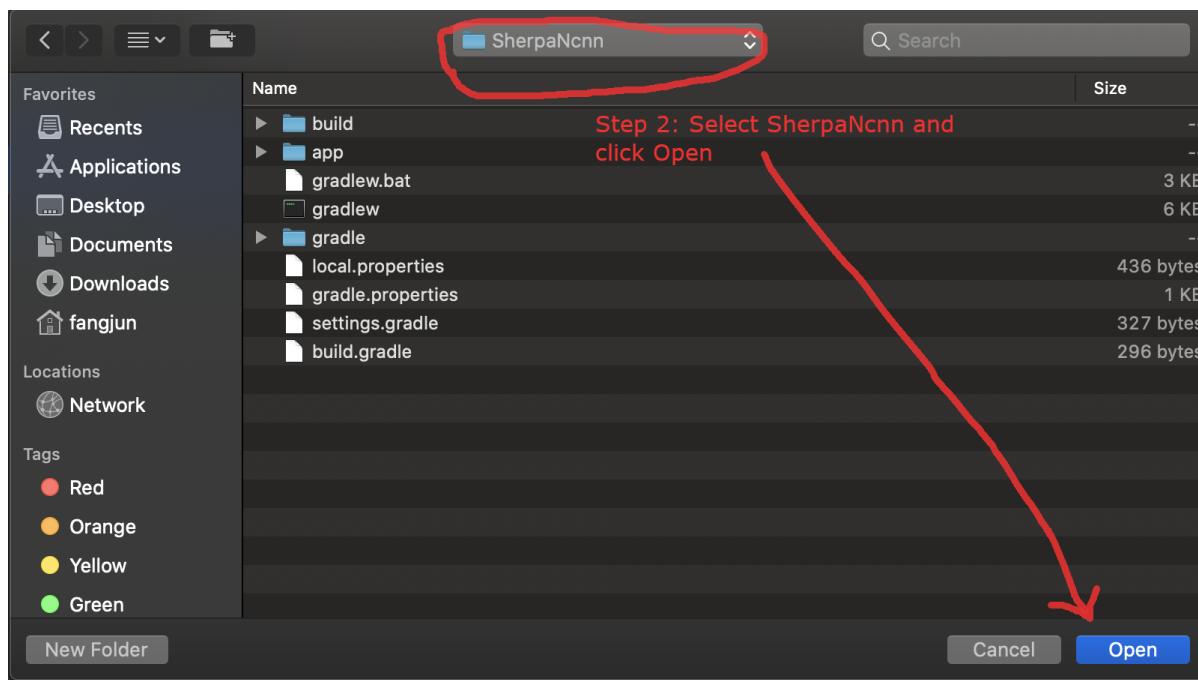


Fig. 7.2: Step 2: Open SherpaNcnn.

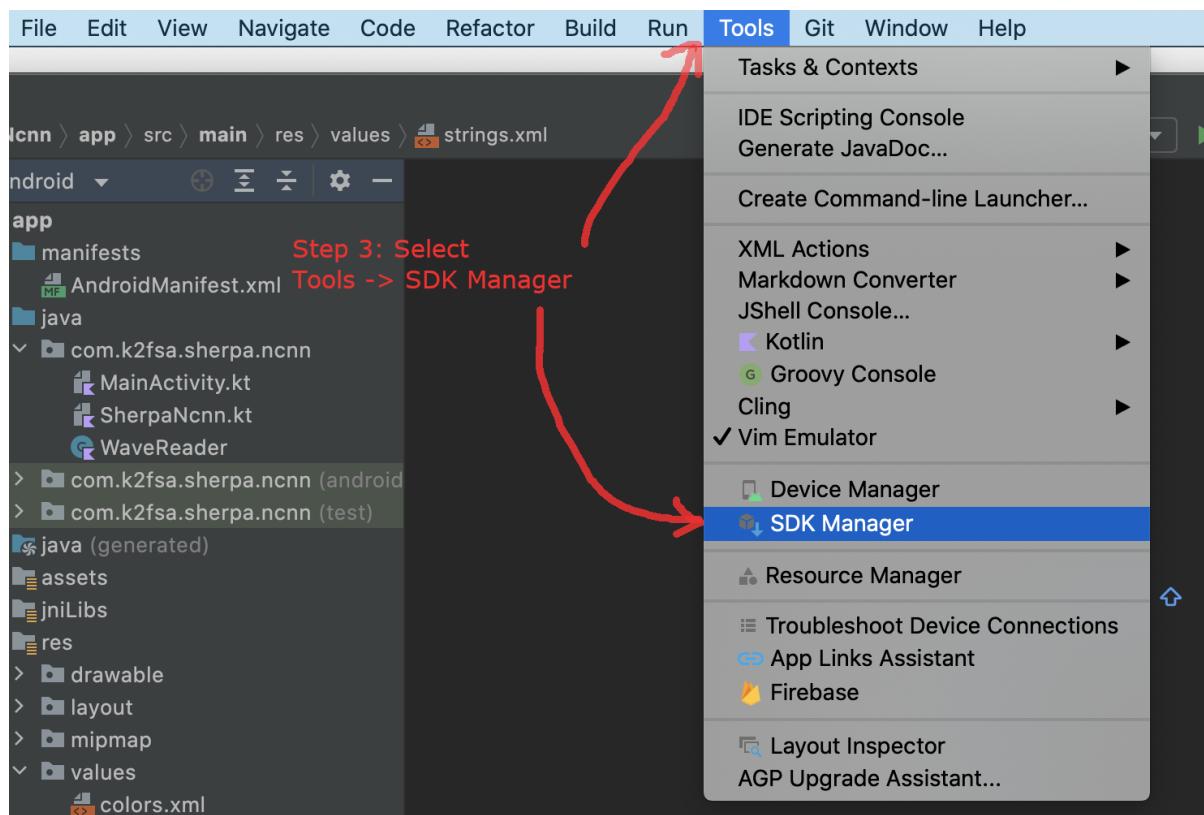


Fig. 7.3: Step 3: Select Tools -> SDK Manager.

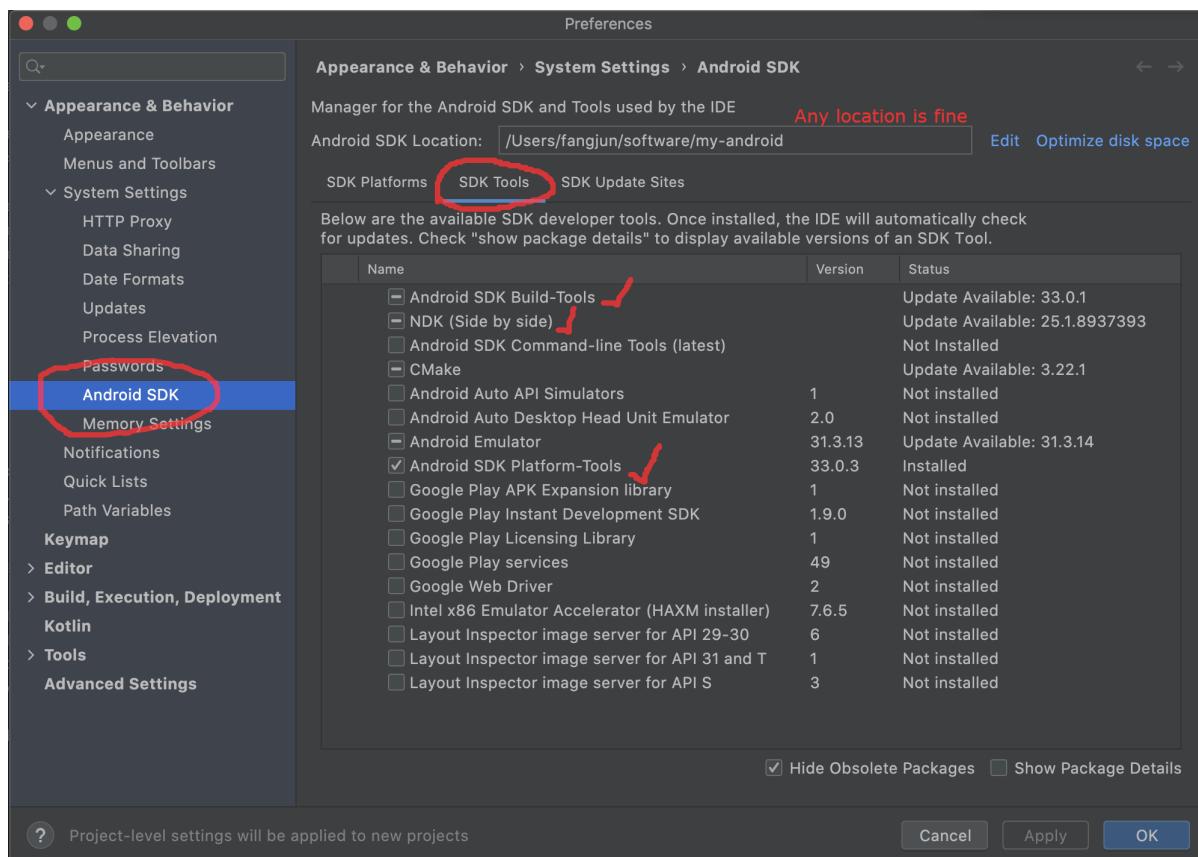


Fig. 7.4: Step 4: Install NDK.

```
export ANDROID_NDK=/Users/fangjun/software/my-android/ndk/22.1.7171670
```

---

**Note:** Note from <https://github.com/Tencent/ncnn/wiki/how-to-build#build-for-android>

(Important) remove the hardcoded debug flag in Android NDK to fix the android-ndk issue: <https://github.com/android/ndk/issues/243>

1. open \$ANDROID\_NDK/build/cmake/android.toolchain.cmake for ndk < r23 or \$ANDROID\_NDK/build/cmake/android-legacy.toolchain.cmake for ndk >= r23

2. delete the line containing “-g”

```
list(APPEND ANDROID_COMPILER_FLAGS
-g
-DANDROID
```

---

**Caution:** If you don't delete the line containin -g above, the generated library libncnn.so can be as large as 21 MB or even larger!

### Build sherpa-ncnn (C++ code)

After installing NDK, it is time to build the C++ code of sherpa-ncnn.

In the following, we show how to build `sherpa-ncnn` for the following Android ABIs:

- arm64-v8a
- armeabi-v7a
- x86\_64
- x86

---

**Caution:** You only need to select one and only one ABI. `arm64-v8a` is probably the most common one.

If you want to test the app on an emulator, you probably need `x86_64`.

---

**Hint:** Building scripts for this section are for macOS and Linux. If you are using Windows or if you don't want to build the shared libraries by yourself, you can download pre-compiled shared libraries for this section by visiting

<https://github.com/k2-fsa/sherpa-ncnn/releases>

---

**Hint:** We provide a colab notebook for you to try this section step by step.

If you are using Windows or you don't want to setup your local environment to build the C++ libraries, please use the above colab notebook.

## Build for arm64-v8a

```
cd sherpa-ncnn # Go to the root repo
./build-android-arm64-v8a.sh
```

After building, you will find the following shared libraries:

```
$ ls -lh build-android-arm64-v8a/install/lib/lib*.so
-rwxr-xr-x 1 fangjun staff 848K Dec 18 16:49 build-android-arm64-v8a/install/lib/
↳ libkaldi-native-fbank-core.so
-rwxr-xr-x 1 fangjun staff 3.4M Dec 18 16:49 build-android-arm64-v8a/install/lib/
↳ libncnn.so
-rwxr-xr-x 1 fangjun staff 195K Dec 18 16:49 build-android-arm64-v8a/install/lib/
↳ libsherpa-ncnn-core.so
-rwxr-xr-x 1 fangjun staff 19K Dec 18 16:49 build-android-arm64-v8a/install/lib/
↳ libsherpa-ncnn-jni.so
```

Please copy them to android/SherpaNcnn/app/src/main/jniLibs/arm64-v8a/:

```
$ cp build-android-arm64-v8a/install/lib/lib*.so android/SherpaNcnn/app/src/main/
↳ jniLibs/arm64-v8a/
```

You should see the following screen shot after running the above copy cp command.

**Note:** If you have Android >= 7.0 and want to run `sherpa-ncnn` on GPU, please replace `./build-android-arm64-v8a.sh` with `./build-android-arm64-v8a-with-vulkan.sh` and replace `build-android-arm64-v8a/install/lib/lib*.so` with `./build-android-arm64-v8a-with-vulkan/install/lib/lib*.so`. That is all you need to do and you don't need to change any code.

Also, you need to install Vulkan sdk. Please see <https://github.com/k2-fsa/sherpa-ncnn/blob/master/install-vulkan-macos.md> for details.

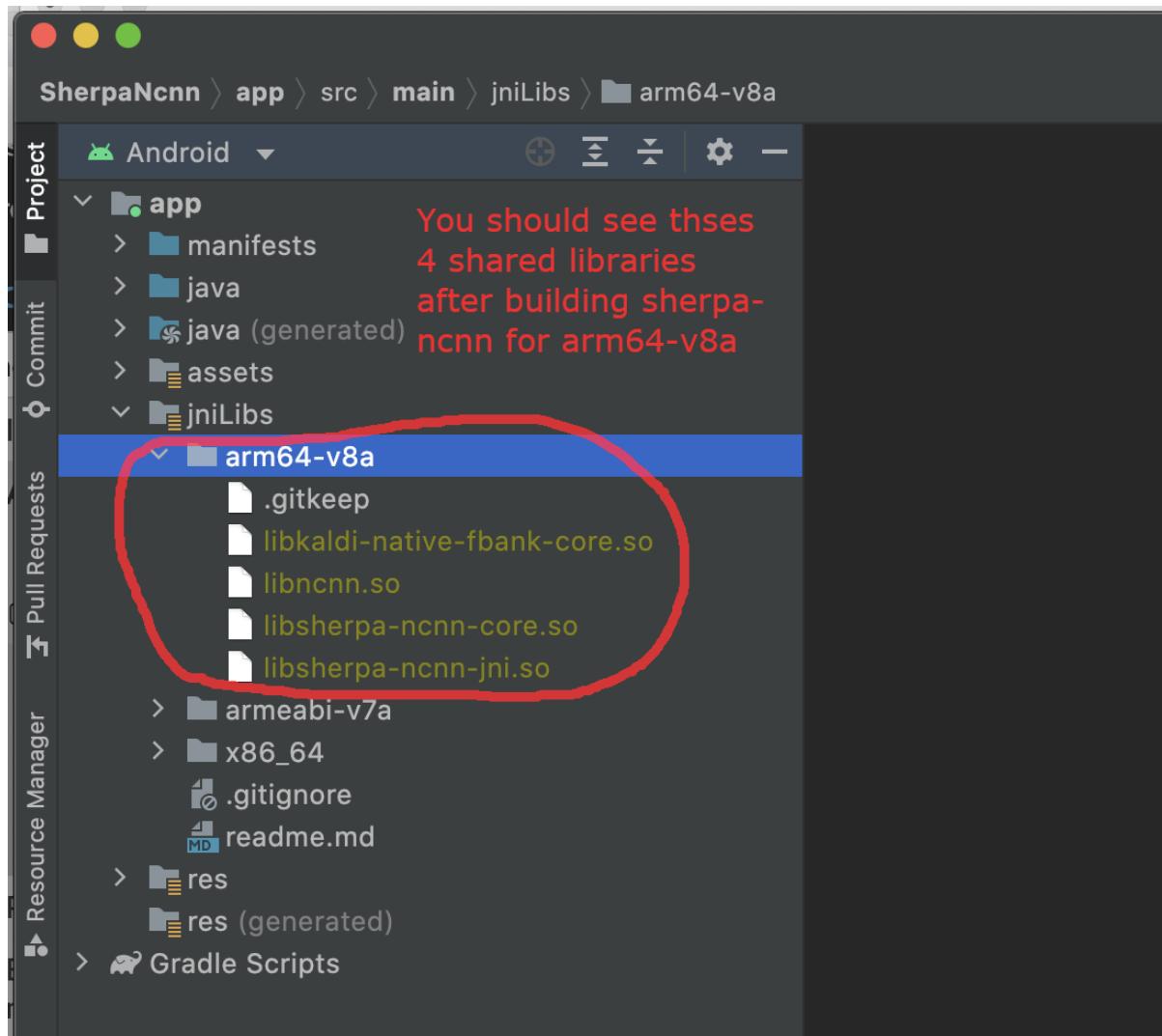
## Build for armeabi-v7a

```
cd sherpa-ncnn # Go to the root repo
./build-android-armv7-eabi.sh
```

After building, you will find the following shared libraries:

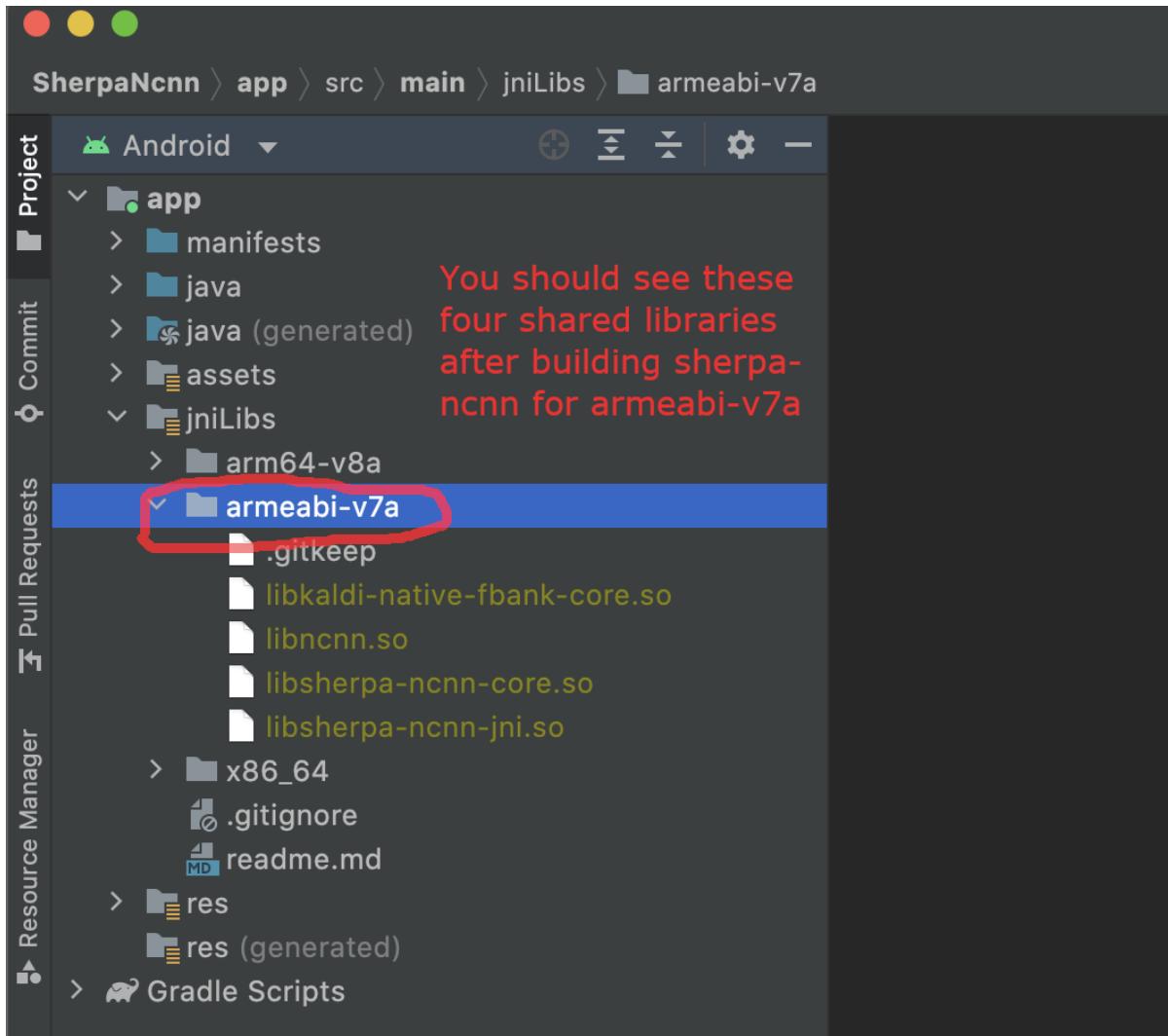
```
$ ls -lh build-android-armv7-eabi/install/lib/lib*.so
-rwxr-xr-x 1 fangjun staff 513K Dec 18 17:04 build-android-armv7-eabi/install/lib/
↳ libkaldi-native-fbank-core.so
-rwxr-xr-x 1 fangjun staff 1.9M Dec 18 17:04 build-android-armv7-eabi/install/lib/
↳ libncnn.so
-rwxr-xr-x 1 fangjun staff 163K Dec 18 17:04 build-android-armv7-eabi/install/lib/
↳ libsherpa-ncnn-core.so
-rwxr-xr-x 1 fangjun staff 28K Dec 18 17:04 build-android-armv7-eabi/install/lib/
↳ libsherpa-ncnn-jni.so
```

Please copy them to android/SherpaNcnn/app/src/main/jniLibs/armeabi-v7a/:



```
cp build-android-armv7-eabi/install/lib/lib*.so android/SherpaNcnn/app/src/main/jniLibs/
↳ armeabi-v7a/
```

You should see the following screen shot after running the above copy cp command.



## Build for x86\_64

```
cd sherpa-ncnn # Go to the root repo
./build-android-x86-64.sh
```

After building, you will find the following shared libraries:

```
$ ls -lh build-android-x86-64/install/lib/lib*.so
-rwxr-xr-x 1 fangjun staff 901K Dec 18 17:14 build-android-x86-64/install/lib/
↳ libkaldi-native-fbank-core.so
-rwxr-xr-x 1 fangjun staff 6.9M Dec 18 17:14 build-android-x86-64/install/lib/
↳ libncnn.so
```

(continues on next page)

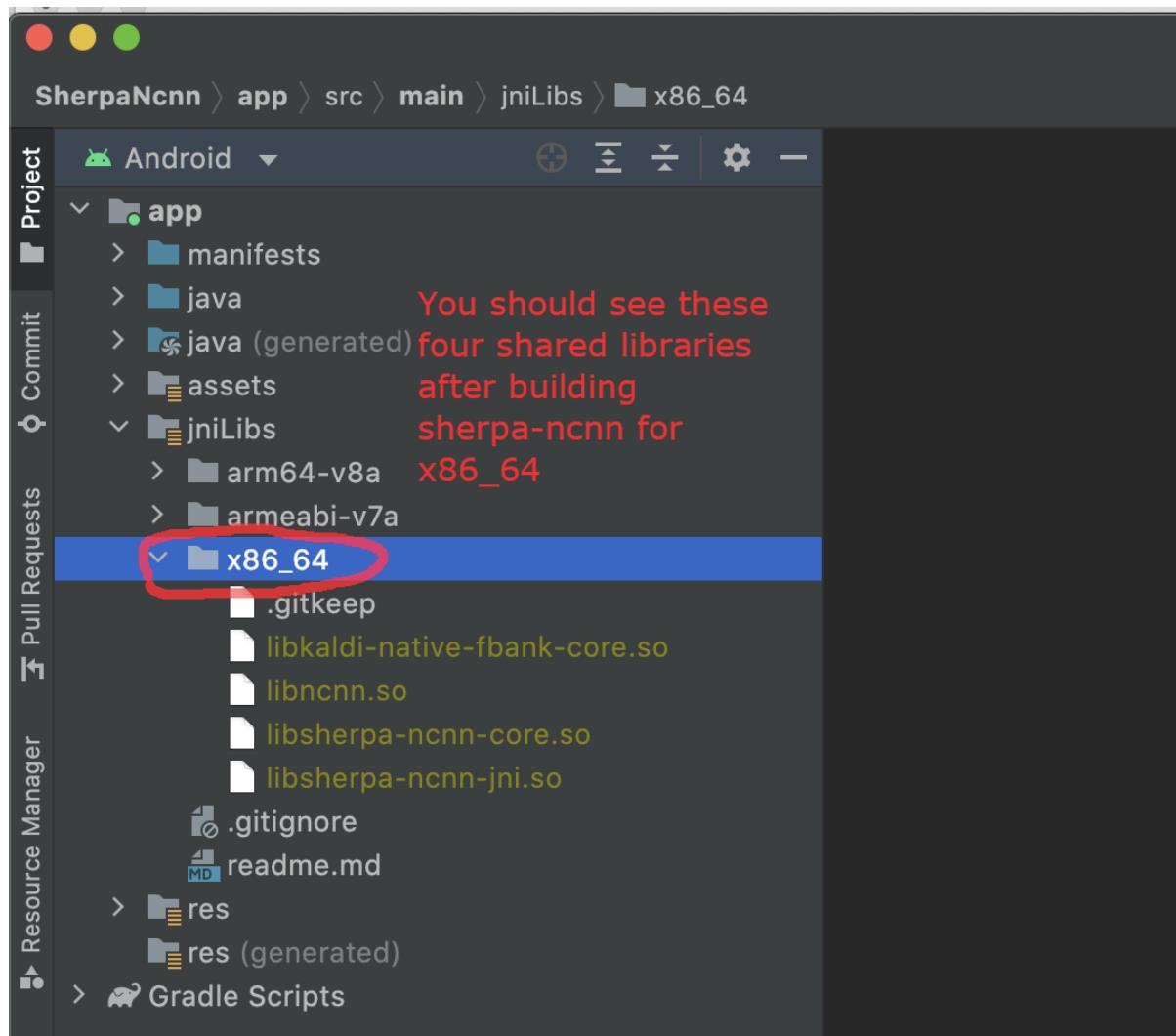
(continued from previous page)

```
-rwxr-xr-x 1 fangjun staff 208K Dec 18 17:14 build-android-x86-64/install/lib/  
↳ libsherpa-ncnn-core.so  
-rwxr-xr-x 1 fangjun staff 19K Dec 18 17:14 build-android-x86-64/install/lib/  
↳ libsherpa-ncnn-jni.so
```

Please copy them to android/SherpaNcnn/app/src/main/jniLibs/x86\_64/:

```
cp build-android-x86-64/install/lib/lib*.so android/SherpaNcnn/app/src/main/jniLibs/x86_64/
```

You should see the following screen shot after running the above copy cp command.



## Build for x86

```
cd sherpa-ncnn # Go to the root repo
./build-android-x86.sh
```

## Download pre-trained models

Please read [Pre-trained models](#) for all available pre-trained models.

In the following, we use a pre-trained model from <https://huggingface.co/csukuangfj/sherpa-ncnn-conv-emformer-transducer-2022-12-06>, which supports both Chinese and English.

**Hint:** The model is trained using `icefall` and the original torchscript model is from <https://huggingface.co/ptrnnull/icefall-asr-conv-emformer-transducer-stateless2-zh>.

Use the following command to download the pre-trained model and place it into `android/SherpaNcnn/app/src/main/assets/`:

```
cd android/SherpaNcnn/app/src/main/assets/
sudo apt-get install git-lfs
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/csukuangfj/sherpa-ncnn-conv-
~emformer-transducer-2022-12-06
cd sherpa-ncnn-conv-emformer-transducer-2022-12-06
git lfs pull --include "*.bin"

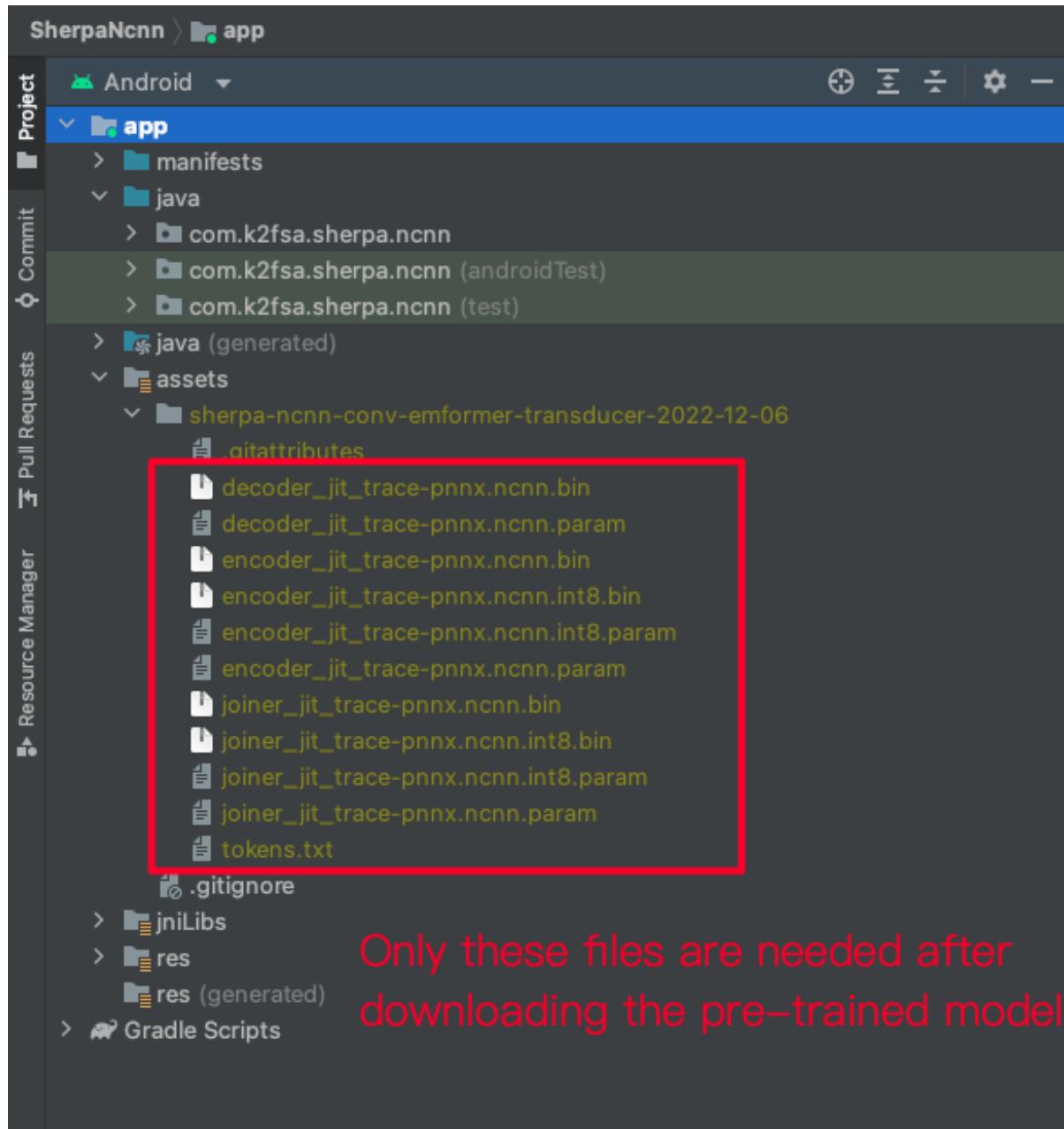
# Now, remove extra files to reduce the file size of the generated apk
rm -rf .git test_wavs scripts/
rm export-for-ncnn.sh *.png README.md
```

In the end, you should have the following files:

```
$ ls -lh
total 525224
-rw-r--r-- 1 fangjun staff  5.9M Dec 18 17:40 decoder_jit_trace-pnnx.ncnn.bin
-rw-r--r-- 1 fangjun staff 439B Dec 18 17:39 decoder_jit_trace-pnnx.ncnn.param
-rw-r--r-- 1 fangjun staff 141M Dec 18 17:40 encoder_jit_trace-pnnx.ncnn.bin
-rw-r--r-- 1 fangjun staff 99M Dec 18 17:40 encoder_jit_trace-pnnx.ncnn.int8.bin
-rw-r--r-- 1 fangjun staff 78K Dec 18 17:40 encoder_jit_trace-pnnx.ncnn.int8.param
-rw-r--r-- 1 fangjun staff 79K Dec 18 17:39 encoder_jit_trace-pnnx.ncnn.param
-rw-r--r-- 1 fangjun staff 6.9M Dec 18 17:40 joiner_jit_trace-pnnx.ncnn.bin
-rw-r--r-- 1 fangjun staff 3.5M Dec 18 17:40 joiner_jit_trace-pnnx.ncnn.int8.bin
-rw-r--r-- 1 fangjun staff 498B Dec 18 17:40 joiner_jit_trace-pnnx.ncnn.int8.param
-rw-r--r-- 1 fangjun staff 490B Dec 18 17:39 joiner_jit_trace-pnnx.ncnn.param
-rw-r--r-- 1 fangjun staff  53K Dec 18 17:39 tokens.txt

$ du -h -d1 .
256M .
```

You should see the following screen shot after downloading the pre-trained model:



**Hint:** If you select a different pre-trained model, make sure that you also change the corresponding code listed in the following screen shot:

```

val numBytes = AudioRecord.getMinBufferSize(sampleRateInHz, channelConfig, audioFormat)
Log.i(TAG, "Buffer size in milliseconds: ${numBytes * 1000.0f / sampleRateInHz}")

audioRecord = AudioRecord(audioSource,
    sampleRateInHz,
    channelConfig,
    audioFormat,
    numBytes * numBytes * 2 // a sample has two bytes as we are using 16-bit PCM)

return true

private fun initModel() {
    val featureConfig = getFeatureExtractorConfig()
    sampleRate = 16000.0f
    featureDim = 80
    //Please change the argument "type" if you use a different model
    val modelConfig = getModelConfig(type = 1, useGPU = false)!!
    val decoderConfig = getDecoderConfig(decoderType = "greedy_search", numActivePaths = 4)

    val config = RecognizerConfig(
        featureConfig = featureConfig,
        modelConfig = modelConfig,
        decoderConfig = decoderConfig,
        enableEndpoint = true,
        ruleMinTrailingSilence = 2.0f,
        ruleMinIntraSilence = 0.8f,
        ruleMinUtteranceLength = 20.0f,
    )

    model = SherpaNcnn(
        assetManager = application.assets,
        config = config,
    )
}

```

## Generate APK

Finally, it is time to build `sherpa-ncnn` to generate an APK package.

Select Build -> Make Project, as shown in the following screen shot.

You can find the generated APK in `android/SherpaNcnn/app/build/outputs/apk/debug/app-debug.apk`:

```
$ ls -lh android/SherpaNcnn/app/build/outputs/apk/debug/app-debug.apk
-rw-r--r-- 1 fangjun  staff  152M Dec 18 17:53 android/SherpaNcnn/app/build/outputs/
apk/debug/app-debug.apk
```

Congratulations! You have successfully built an APK for Android.

Read below to learn more.

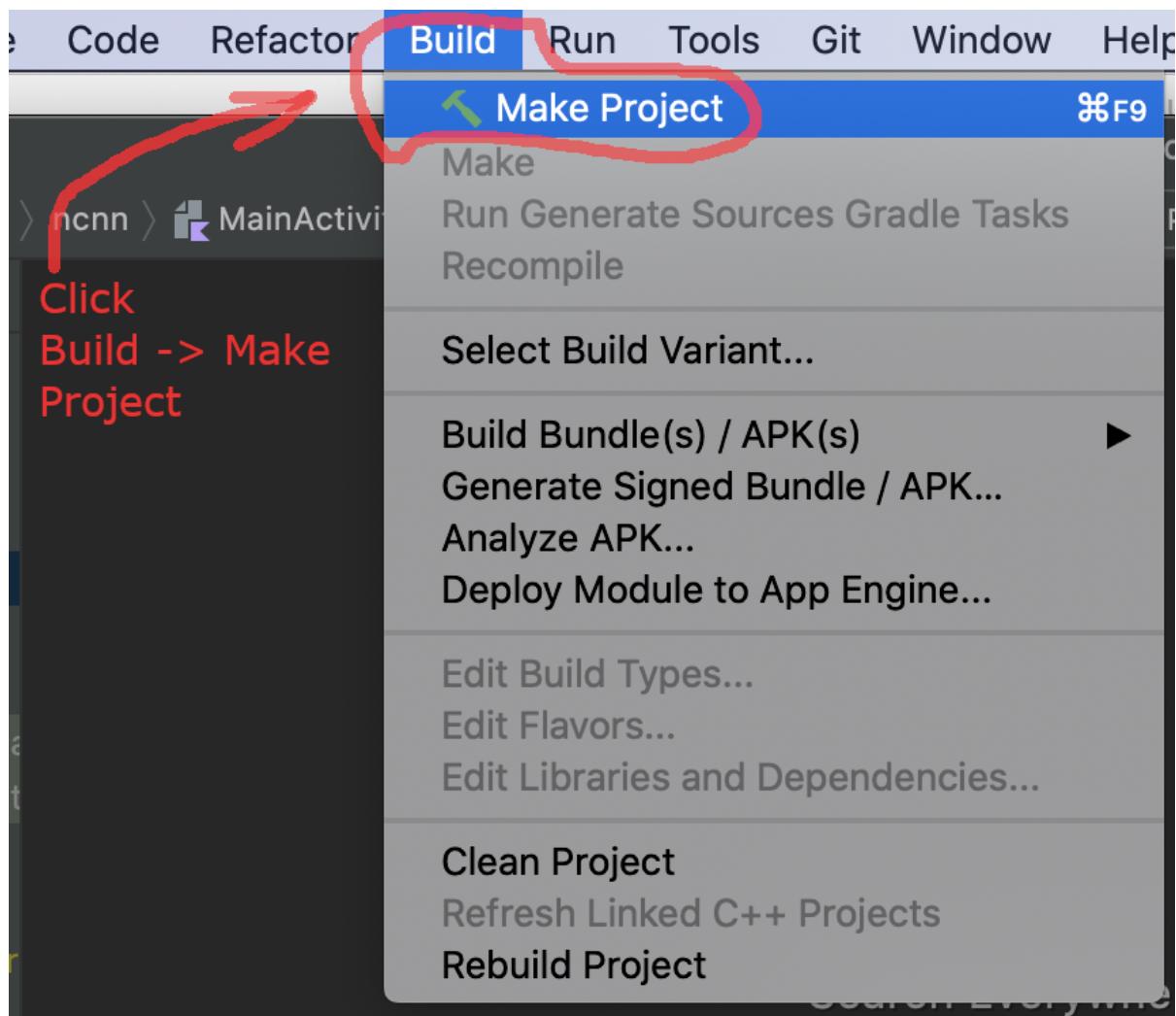
## Analyze the APK

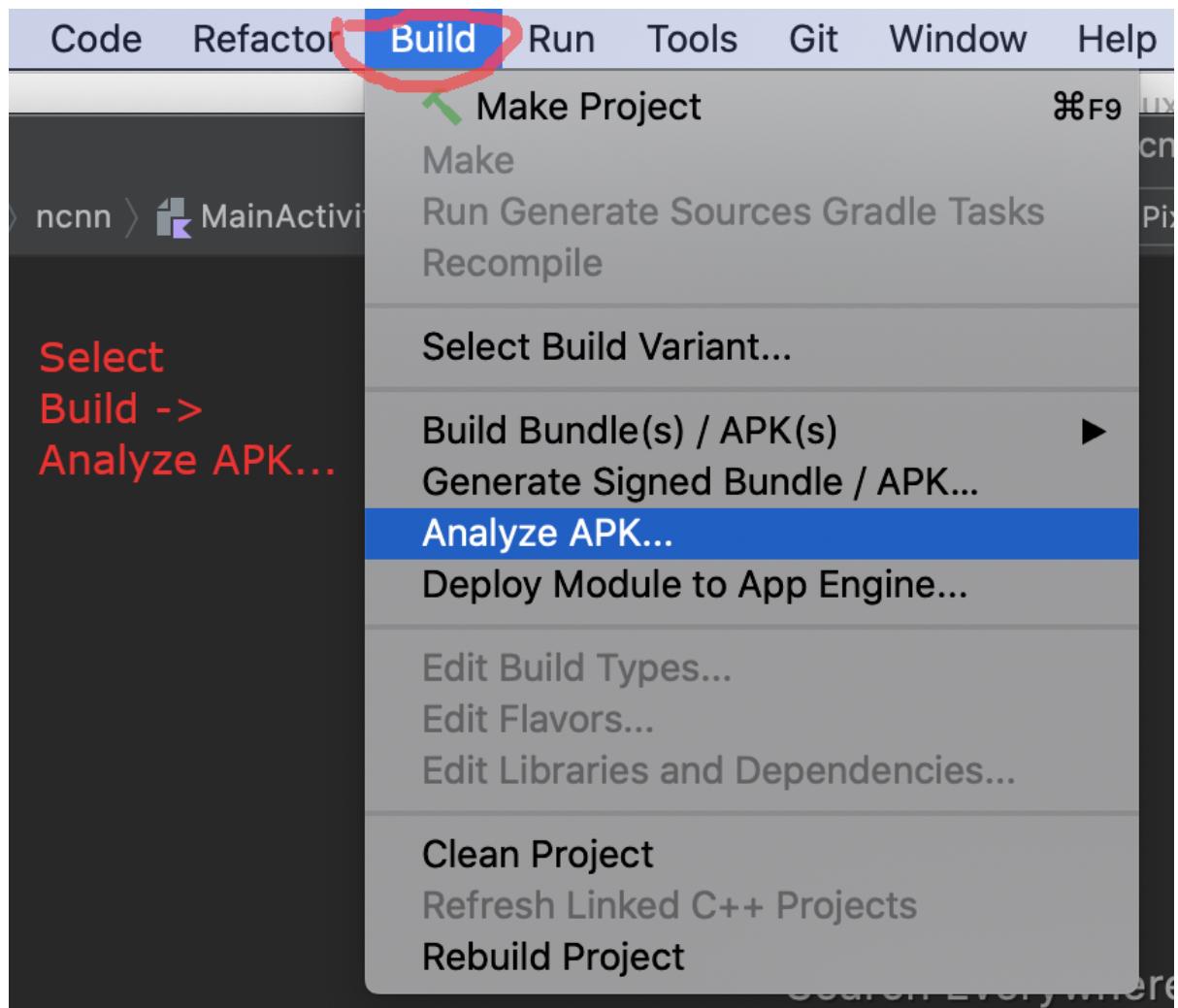
Select Build -> Analyze APK ... in the above screen shot, in the popped-up dialog select the generated APK `app-debug.apk`, and you will see the following screen shot:

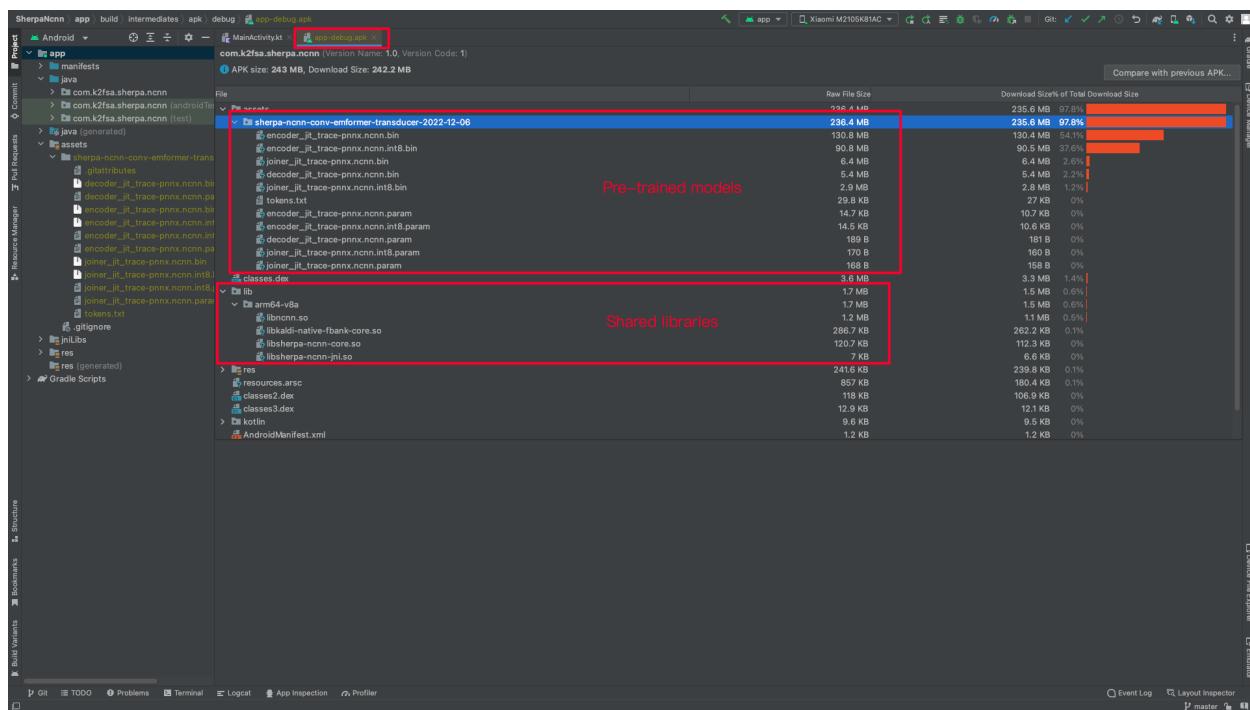
You can see from the above screen shot that most part of the APK is occupied by the pre-trained model, while the runtime, including the shared libraries, is only 1.7 MB.

**Hint:** We have pre-built APKs that can be downloaded from <https://huggingface.co/csukuangfj/sherpa-ncnn-apk>

Please refer to demo videos about using the above APKs: [Video demos](#).







## 7.8 iOS

In this section, we describe how to build an iOS app for **real-time** speech recognition with **sherpa-ncnn** and run it within a simulator on your Mac, run it on you iPhone or iPad.

We also provide video demos for real-time speech recognition.

---

**Hint:** During speech recognition, it does not need to access the Internet. Everyting is processed locally on your iPhone or iPad.

---

### 7.8.1 Video demos

In this page, we list some videos about using **sherpa-ncnn** for real-time speech recognition on iPhone and iPad.

**Video 1: Chinese + English on iPhone 14 Pro (simulator)**

**Video 2: Chinese + English on iPad 11 Pro (simulator)**

### 7.8.2 Build **sherpa-ncnn** for iOS

This section describes how to build **sherpa-ncnn** for iPhone and iPad.

## Requirement

**Warning:** The minimum deployment requires the iOS version >= 13.0.

Before we continue, please make sure the following requirements are satisfied:

- macOS. It won't work on Windows or Linux.
- Xcode. The version 14.2 (14C18) is known to work. Other versions may also work.
- CMake. CMake 3.25.1 is known to work. Other versions may also work.
- (Optional) iPhone or iPad. This is for testing the app on your device. If you don't have a device, you can still run the app within a simulator on your Mac.

### Caution:

If you get the following error:

```
CMake Error at toolchains/ios.toolchain.cmake:544 (get_filename_component):
  get_filename_component called with incorrect number of arguments
Call Stack (most recent call first):
  /usr/local/Cellar/cmake/3.29.0/share/cmake/Modules/CMakeDetermineSystem.
  ↵cmake:146 (include)
  CMakeLists.txt:2 (project)
```

please run:

```
sudo xcode-select --install
sudo xcodebuild -license
```

And then delete the build directory ./build-ios and re-build.

Please see also <https://github.com/k2-fsa/sherpa-onnx/issues/702>.

## Download sherpa-ncnn

First, let us download the source code of `sherpa-ncnn`.

**Note:** In the following, I will download `sherpa-ncnn` to `$HOME/open-source`, i.e., `/Users/fangjun/open-source`, on my Mac.

You can put it anywhere as you like.

```
mkdir -p $HOME/open-source
cd $HOME/open-source
git clone https://github.com/k2-fsa/sherpa-ncnn
```

## Build sherpa-ncnn (in commandline, C++ Part)

After downloading [sherpa-ncnn](#), let us build the C++ part of [sherpa-ncnn](#).

```
cd $HOME/open-source/sherpa-ncnn/  
./build-ios.sh
```

It will generate a directory `$HOME/open-source/sherpa-ncnn/build-ios`, which we have already pre-configured for you in Xcode.

**Hint:** You don't have to look at the generated files in `$HOME/open-source/sherpa-ncnn/build-ios` to build an app. We have pre-configured it for you.

If you are eager to learn more about the generated files or want to use [sherpa-ncnn](#) in your own iOS project, please have a look at [For the more curious](#).

## Build sherpa-ncnn (in Xcode)

Use the following command to open [sherpa-ncnn](#) in Xcode:

```
cd $HOME/open-source/sherpa-ncnn/ios-swift/SherpaNcnn  
open SherpaNcnn.xcodeproj
```

It will start Xcode and you will see the following screenshot:

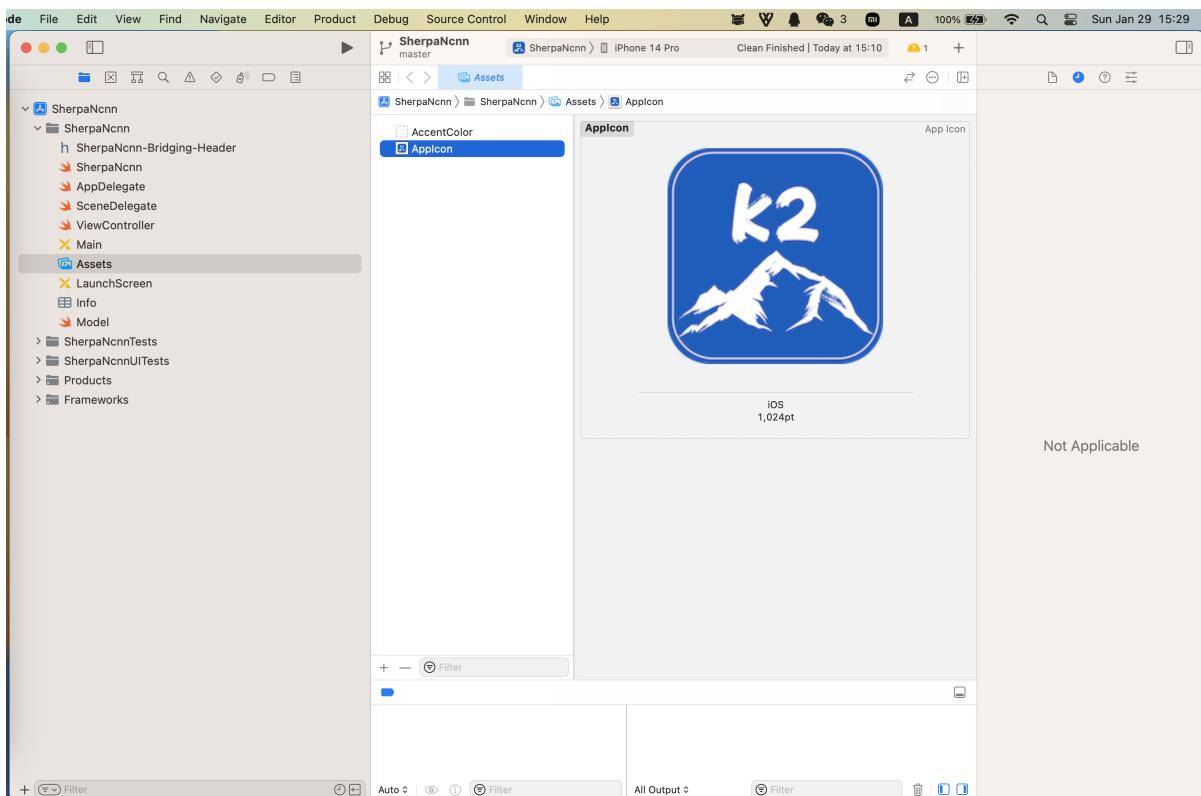


Fig. 7.5: Screenshot after running the command `open SherpaNcnn.xcodeproj`

Please select **Product** -> **Build** to build the project. See the screenshot below:

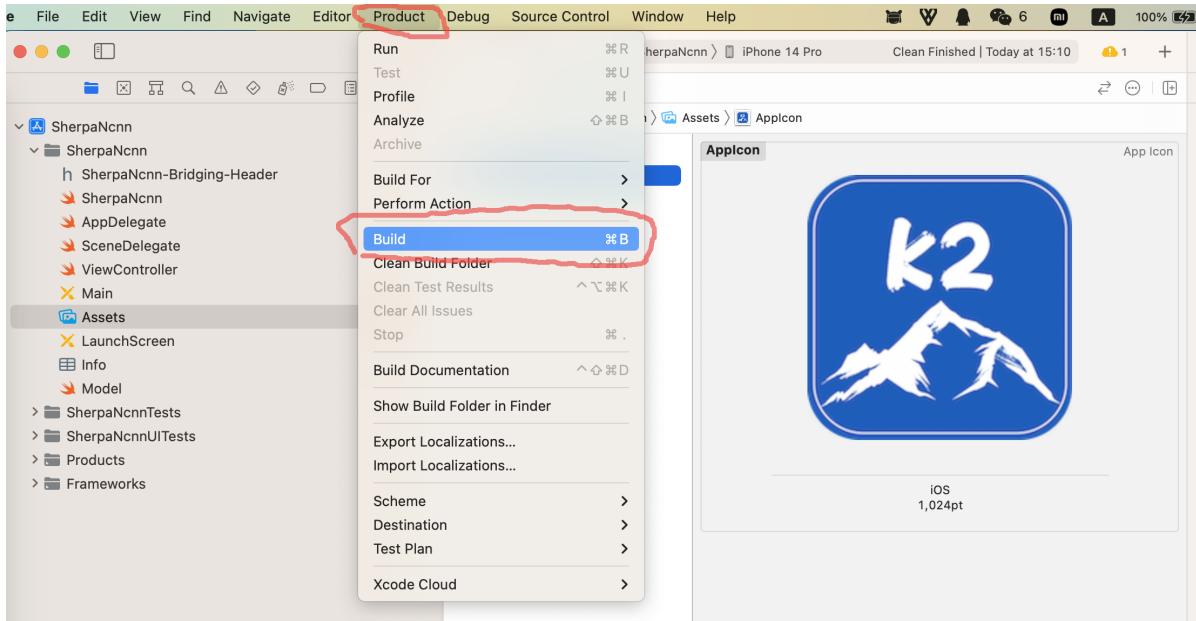


Fig. 7.6: Screenshot for selecting **Product** -> **Build**

After finishing the build, you should see the following screenshot:

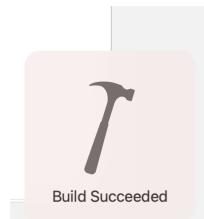


Fig. 7.7: Screenshot after finishing the build.

Congratulations! You have successfully built the project. Let us run the project by selecting **Product** -> **Run**, which is shown in the following screenshot:

Please wait for a few seconds before Xcode starts the simulator.

Unfortunately, it will throw the following error:

The reason for the above error is that we have not provided the pre-trained model yet.

The file `ViewController.swift` pre-selects the pre-trained model to be `csukuangfj/sherpa-ncnn-conv-emformer-transducer-2022-12-06 (Chinese + English)`, shown in the screenshot below:

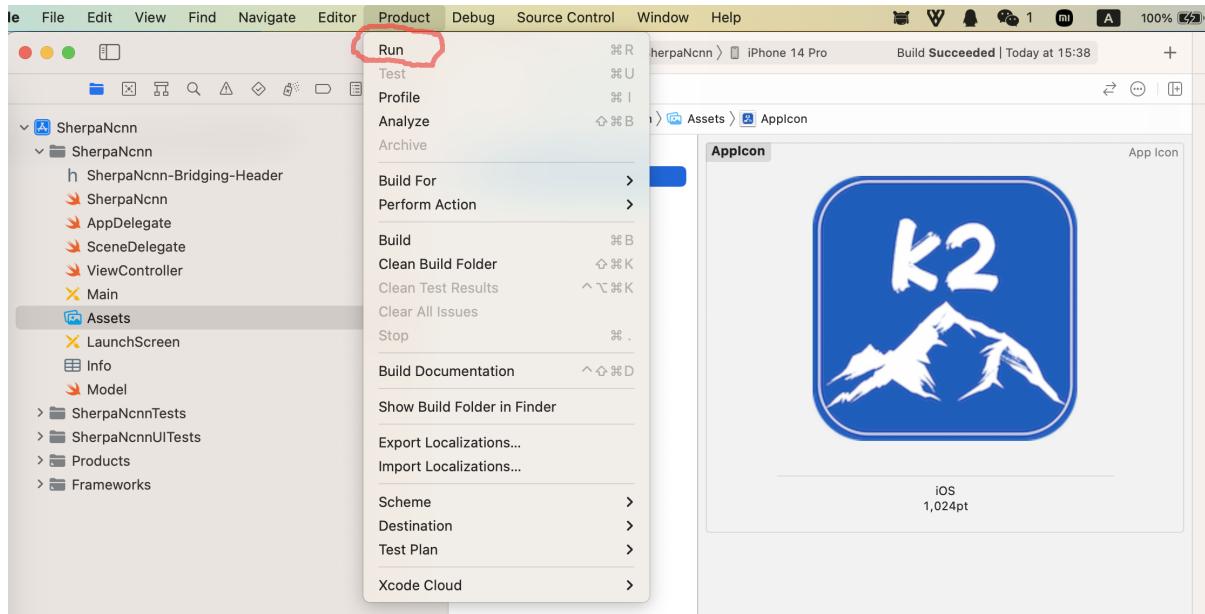


Fig. 7.8: Screenshot for Product -> Run.

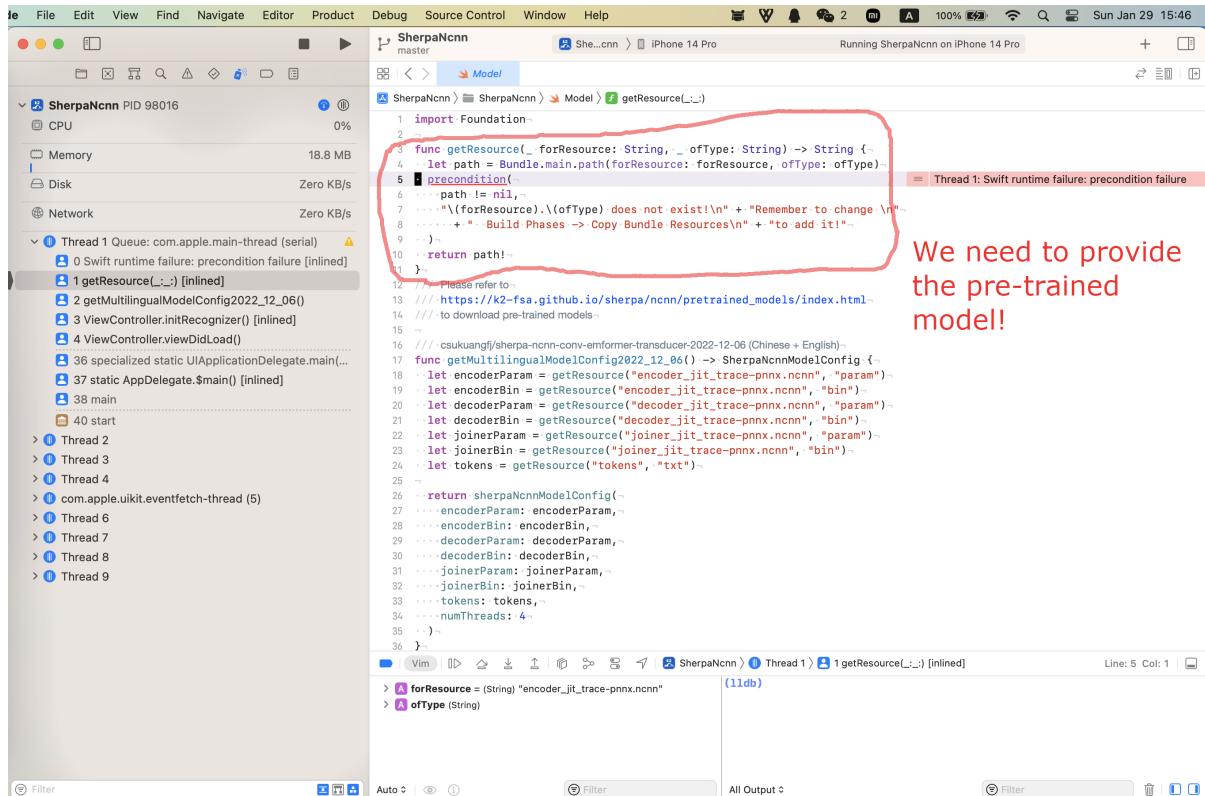


Fig. 7.9: Screenshot for the error

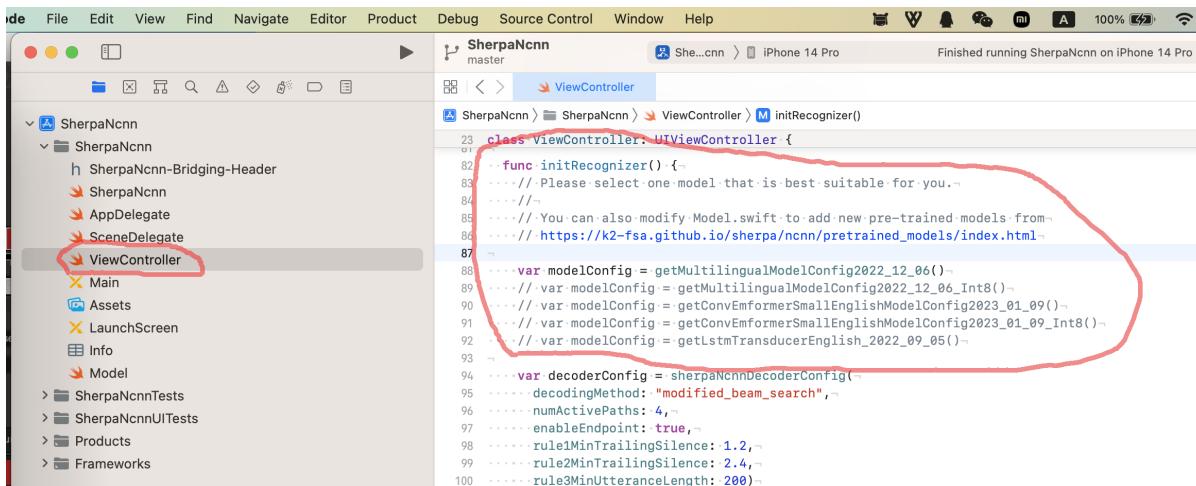


Fig. 7.10: Screenshot for the pre-selected pre-trained model

Let us add the pre-trained model [csukuangfj/sherpa-ncnn-conv-emformer-transducer-2022-12-06 \(Chinese + English\)](https://huggingface.co/csukuangfj/sherpa-ncnn-conv-emformer-transducer-2022-12-06) to Xcode. Please follow [csukuangfj/sherpa-ncnn-conv-emformer-transducer-2022-12-06 \(Chinese + English\)](https://huggingface.co/csukuangfj/sherpa-ncnn-conv-emformer-transducer-2022-12-06) to download it from [huggingface](https://huggingface.com). You can download it to any directory as you like.

Please right click the project SherpaNcnn and select **Add Files to "SherpaNcnn"...** in the popup menu, as is shown in the screenshot below:

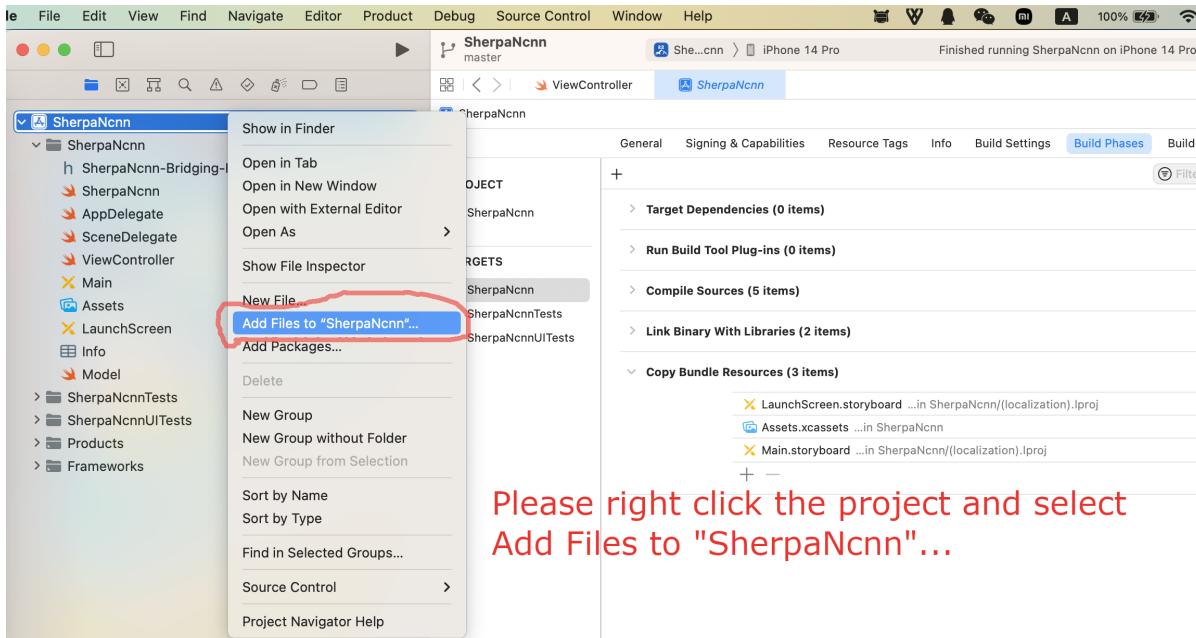


Fig. 7.11: Screenshot for adding files to SherpaNcnn

In the popup dialog, switch to the folder where you just downloaded the pre-trained model.

In the screenshot below, it is the folder `/Users/fangjun/open-source/icefall-models/sherpa-ncnn-conv-emformer-transducer-2022-12-06`:

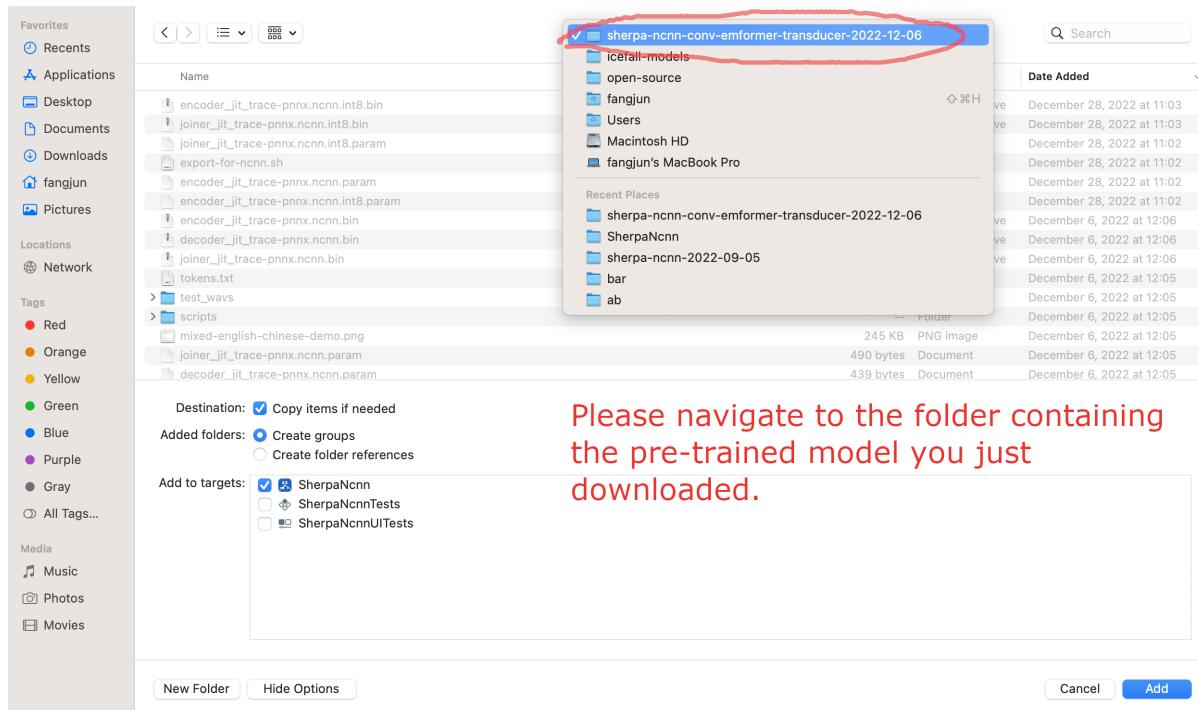


Fig. 7.12: Screenshot for navigating to the folder containing the downloaded pre-trained

Select required files and click the button **Add**:

After adding pre-trained model files to Xcode, you should see the following screenshot:

At this point, you should be able to select the menu **Product** -> **Run** to run the project and you should finally see the following screenshot:

Click the button to start recording! A screenshot is given below:

Congratulations! You have finally succeeded in running **sherpa-ncnn** with iOS, though it is in a simulator.

Please read below if you want to run **sherpa-ncnn** on your iPhone or iPad.

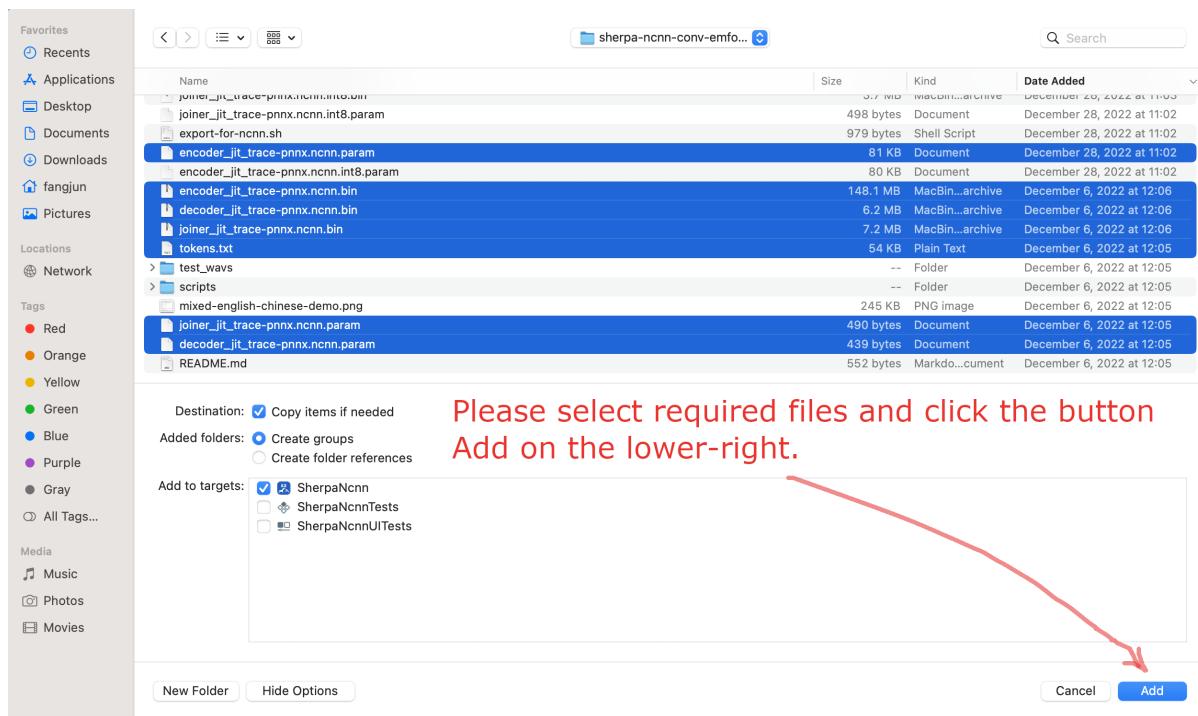


Fig. 7.13: Screenshot for selecting required files

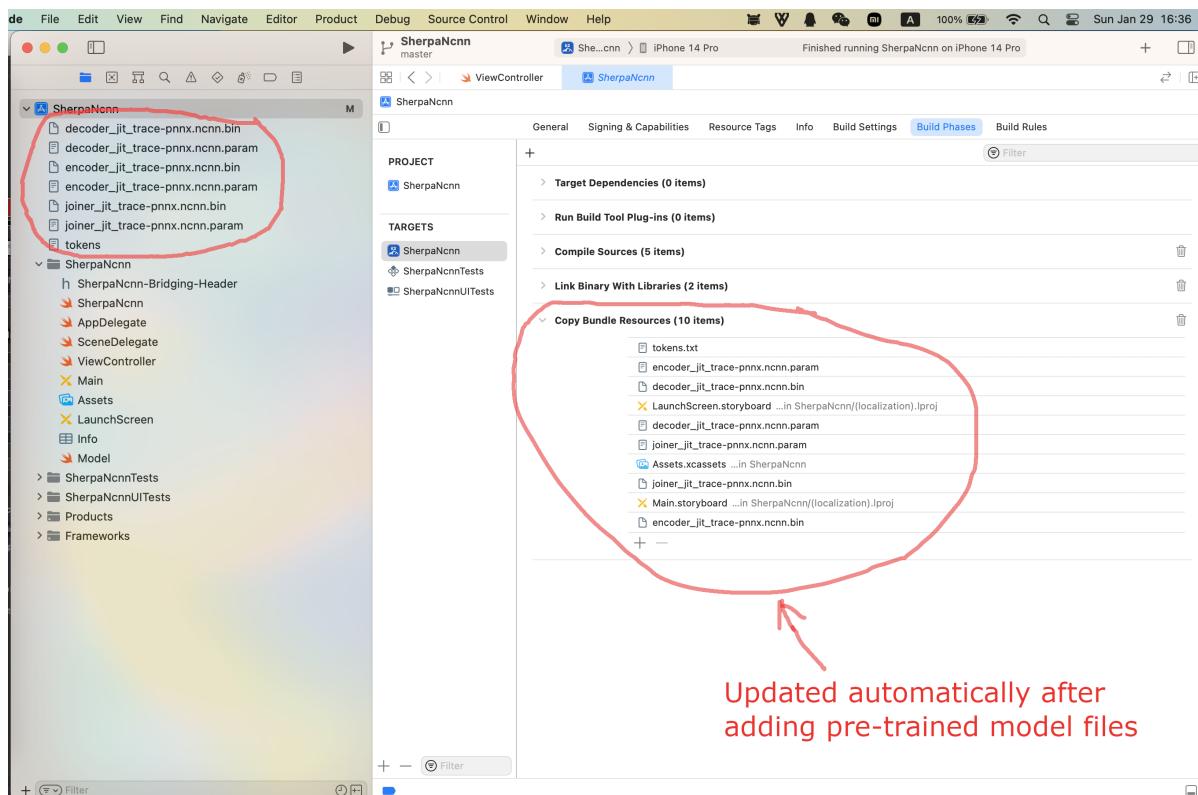


Fig. 7.14: Screenshot after add pre-trained model files

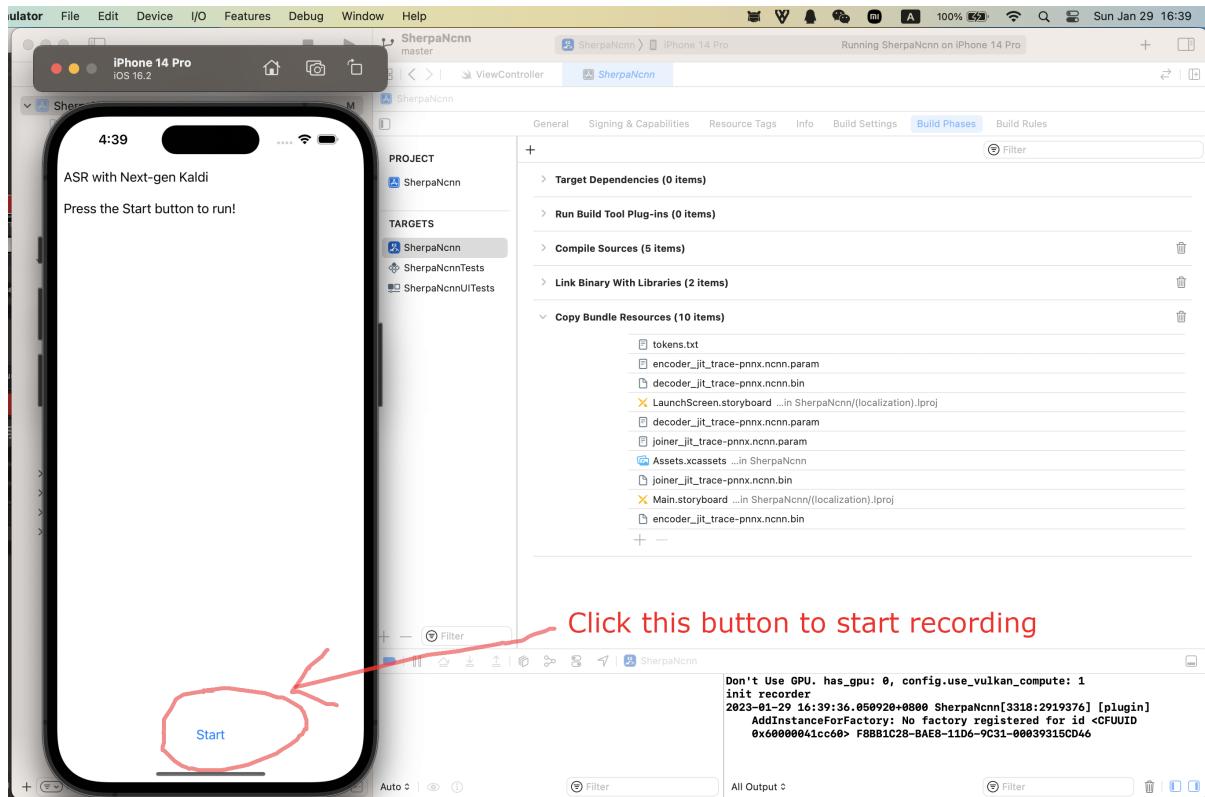


Fig. 7.15: Screenshot for a successful run.

### Run sherpa-ncnn on your iPhone/iPad

First, please make sure the iOS version of your iPhone/iPad is  $\geq 13.0$ .

Click the menu **Xcode**  $\rightarrow$  **Settings...**, as is shown in the following screenshot:

In the popup dialog, please select **Account** and click **+** to add your Apple ID, as is shown in the following screenshots.

After adding your Apple ID, please connect your iPhone or iPad to your Mac and select your device in Xcode. The following screenshot is an example to select my iPhone.

Now your Xcode should look like below after selecting a device:

Please select **Product**  $\rightarrow$  **Run** again to run **sherpa-ncnn** on your selected device, as is shown in the following screenshot:

After a successful build, check your iPhone/iPad and you should see the following screenshot:

To fix that, please select **Settings**  $\rightarrow$  **General**  $\rightarrow$  **Device Management** on your device

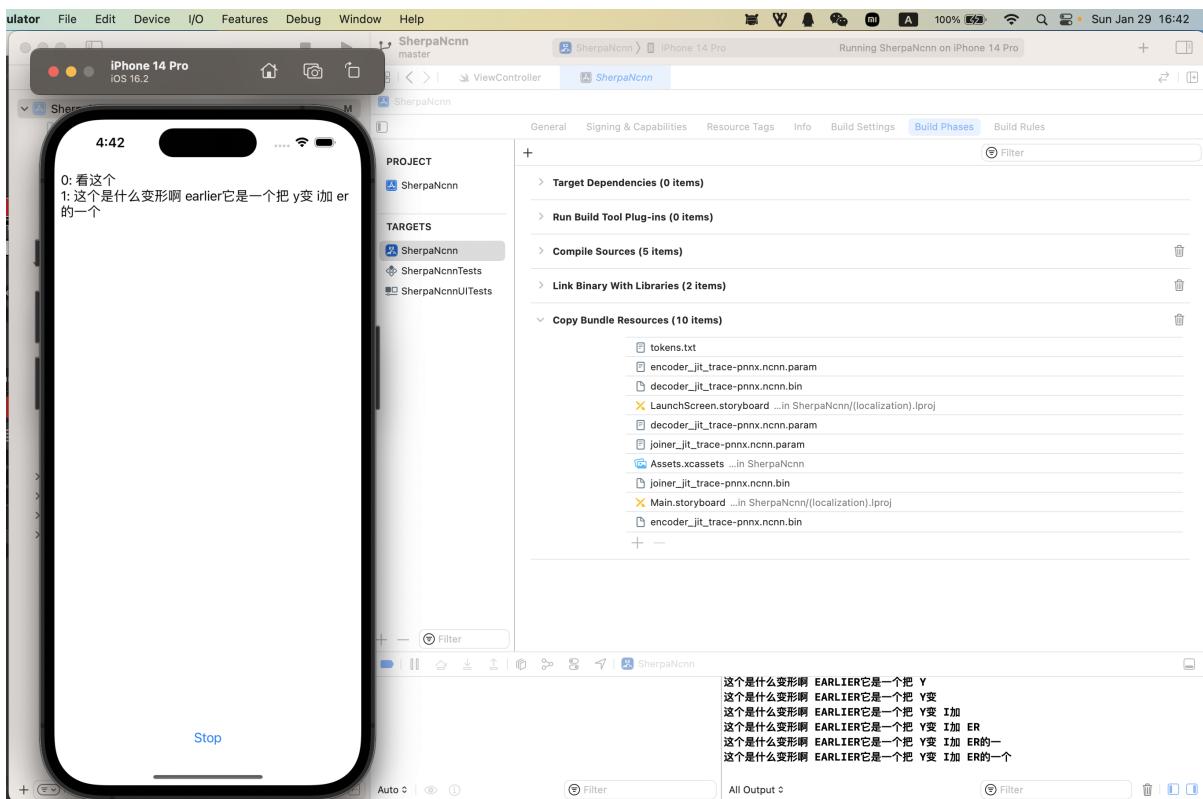


Fig. 7.16: Screenshot for recording and recognition.

Please click Apple Development: csukuangfj... and click Trust "Apple Development: csukuangfj@g..." in the subsequent dialog, as is shown below:

At this point, you should be able to run the app on your device. The following is a screenshot about running it on my iPhone:

Congratulations! You have successfully run `sherpa-ncnn` on your device!

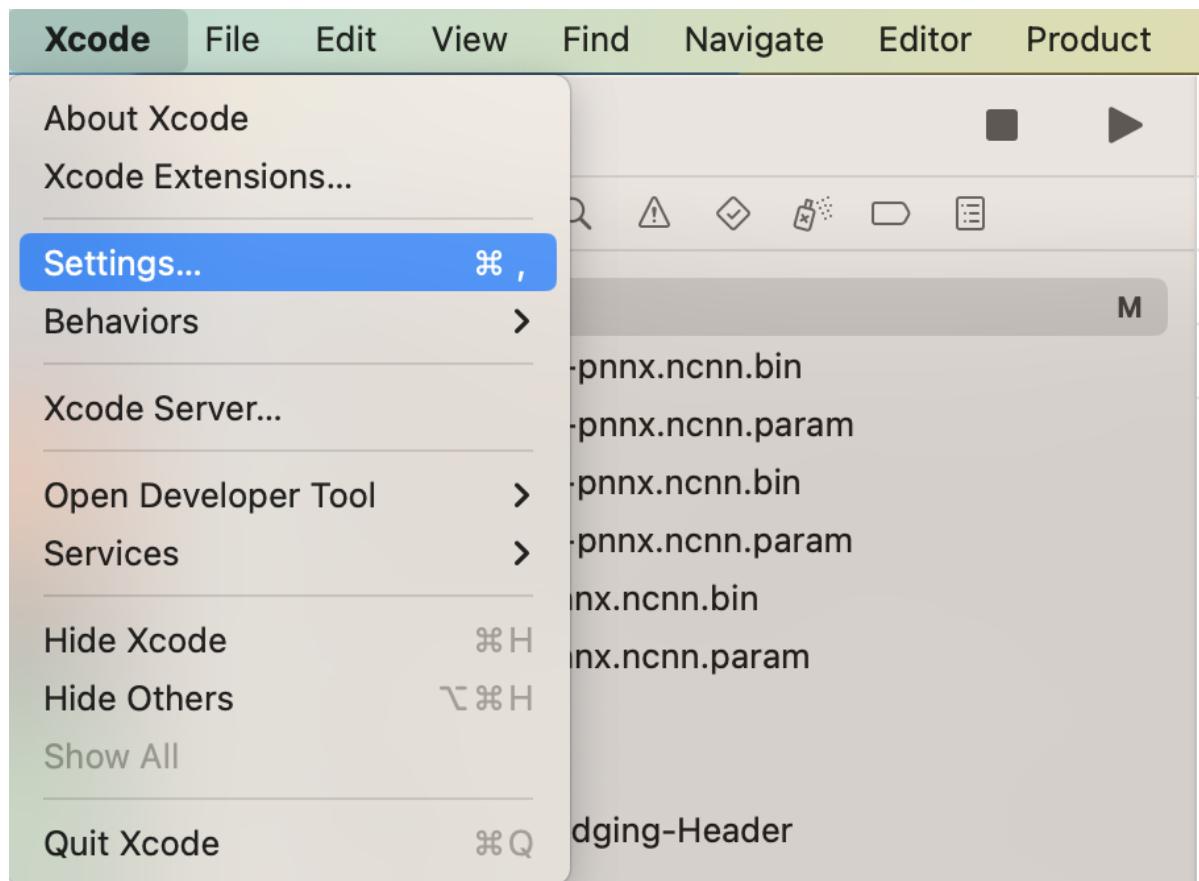


Fig. 7.17: Screenshot for Xcode -> Settings...

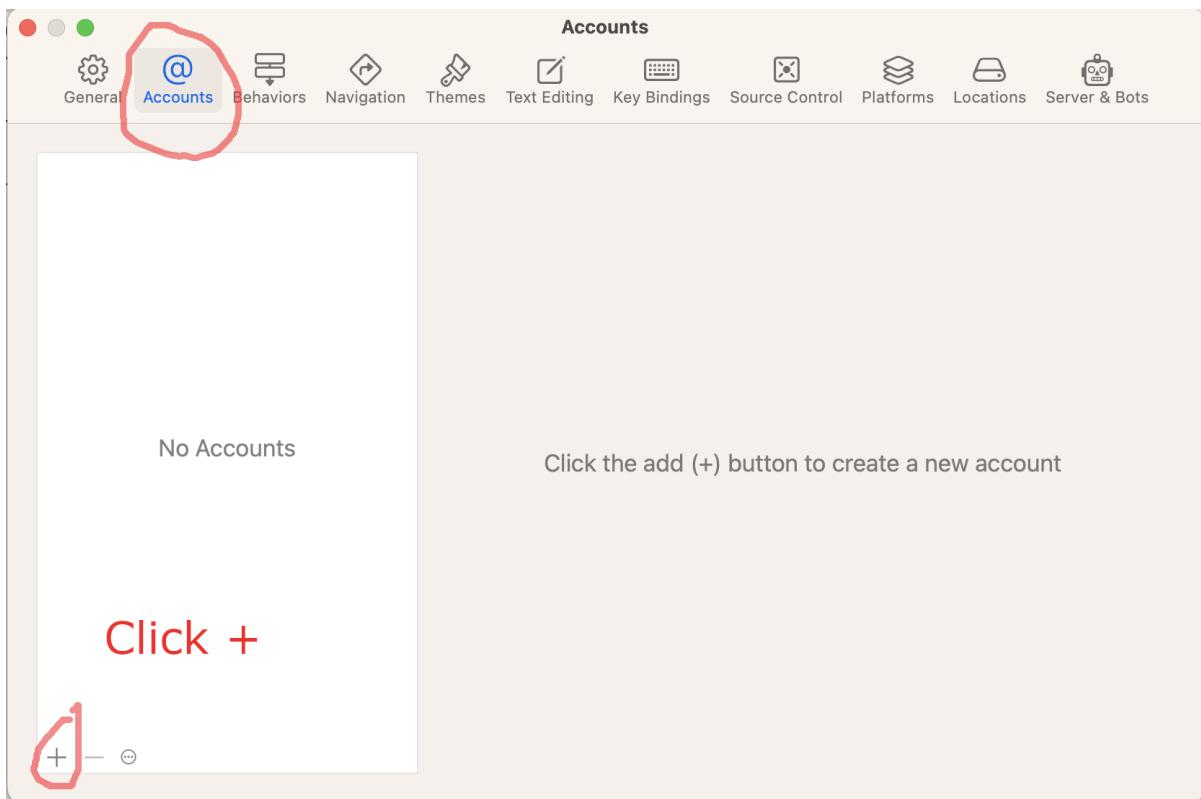


Fig. 7.18: Screenshot for selecting Account and click +.

### 7.8.3 For the more curious

This section is for those who want to learn more about how to use `sherpa-ncnn` in an iOS project.

#### Files generated by running `./build-ios.sh`

After running:

```
./build-ios.sh
```

You may be curious about the generated files.

**Hint:** Please have a look at `./build-ios.sh` so that you know what it does for you.

The above command generates files inside the directory `./build-ios`:

```
sherpa-ncnn fangjun$ ls -lh build-ios
total 1912
drwxr-xr-x  6 fangjun  staff  192B Feb 26 16:48 build
drwxr-xr-x  4 fangjun  staff  128B Feb 26 16:46 install
drwxr-xr-x 15 fangjun  staff  480B Feb 14 18:09 openmp-11.0.0.src
-rw-r--r--  1 fangjun  staff  952K Dec  8 2021 openmp-11.0.0.src.tar.xz
drwxr-xr-x  6 fangjun  staff  192B Feb 26 16:44 openmp.xcframework
drwxr-xr-x  6 fangjun  staff  192B Feb 26 16:48 sherpa-ncnn.xcframework
```

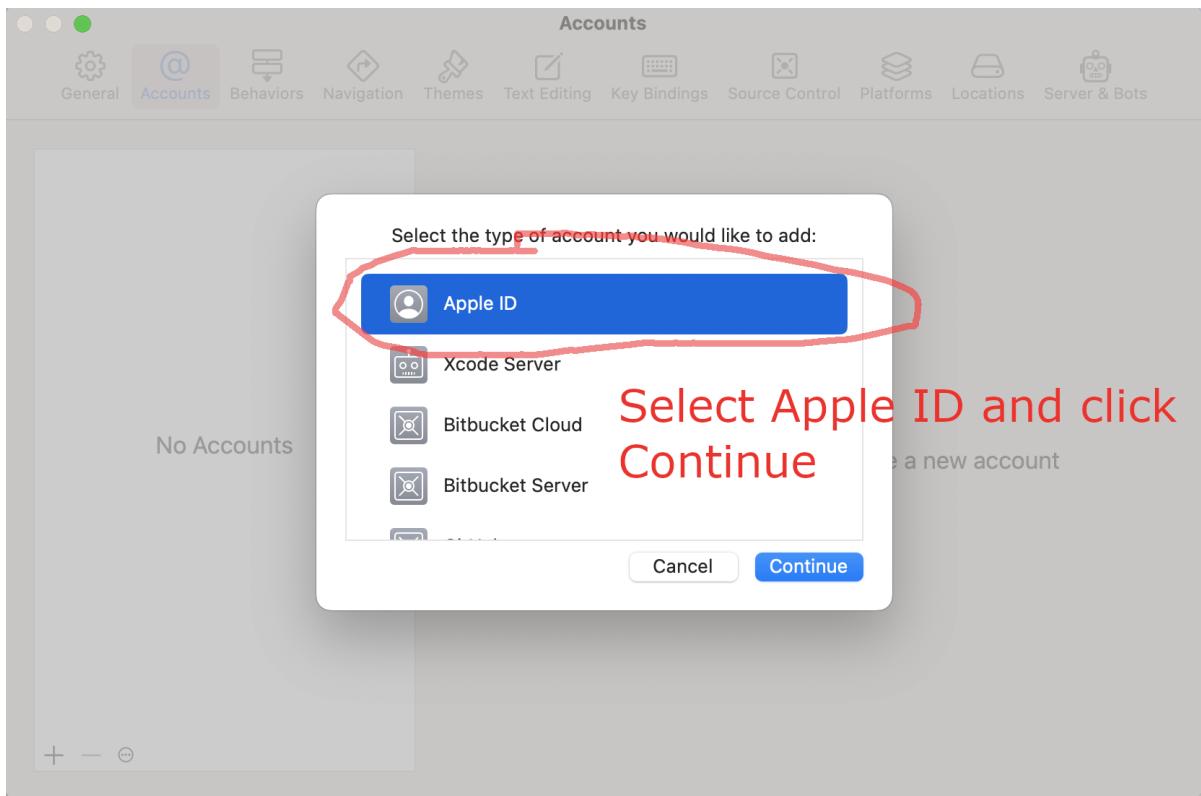


Fig. 7.19: Screenshot for selecting Apple ID and click Continue

What is interesting here is the two framework folders `openmp.xcframework` and `sherpa-ncnn.xcframework`. All other folders can be safely removed. We only need the two framework folders.

In the following, we describe the content in these two framework folders.

### openmp.xcframework

```
$ tree build-ios/openmp.xcframework/
build-ios/openmp.xcframework/
├── Headers
│   └── omp.h
├── Info.plist
└── ios-arm64
    └── libomp.a
```

3 directories, 4 files

#### Explanation:

- `omp.h`: The header file, which is used by `ncnn`
- `Info.plist`: A file that is dedicated for framework on macOS/iOS
- `ios-arm64/libomp.a`: A static library for iOS device, e.g., for iPhone

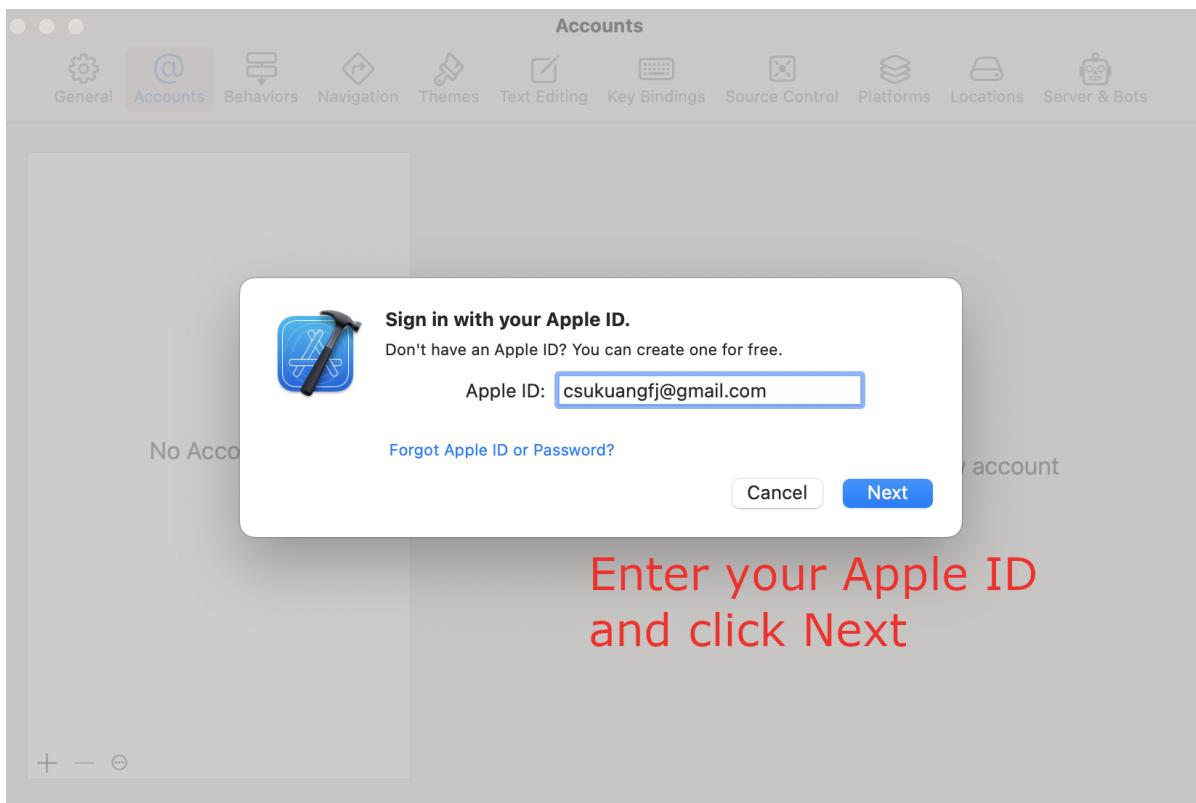


Fig. 7.20: Screenshot for adding your Apple ID and click Next

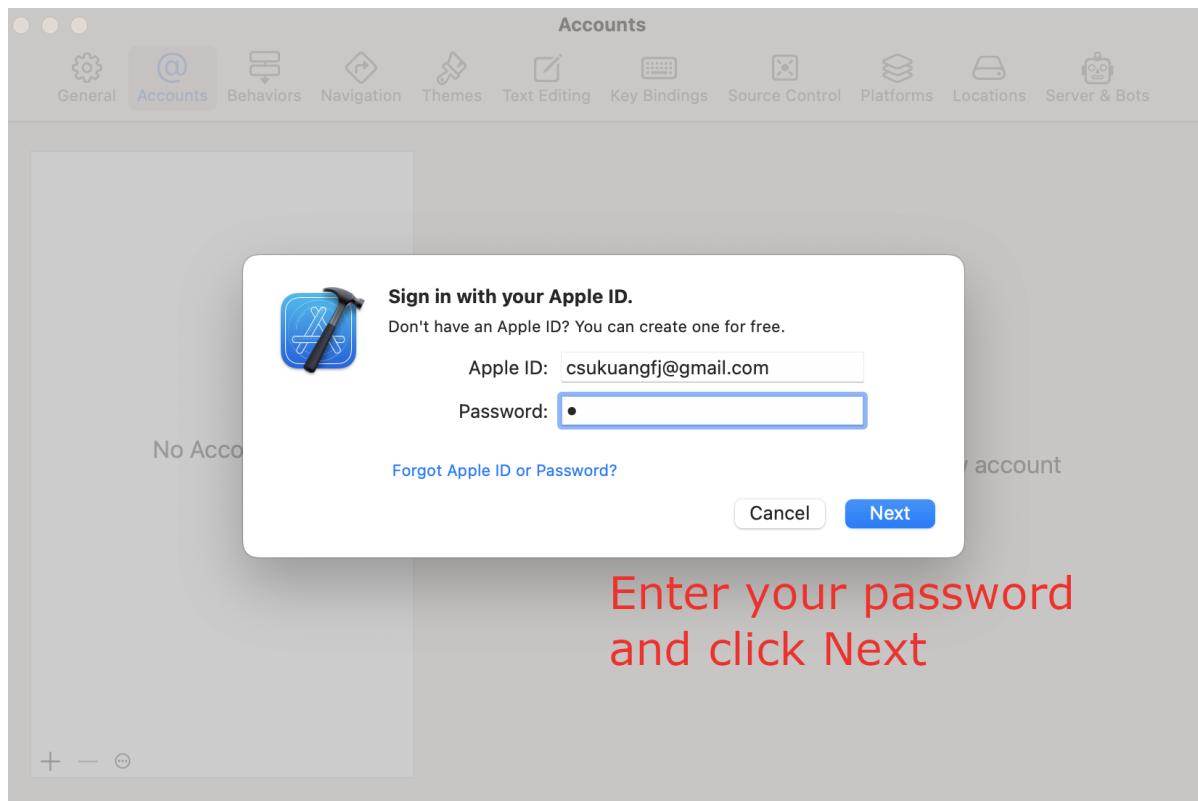
- `ios-arm64_x86_64-simulator/libomp.a`: A static library for iOS simulators, including simulators for Intel chips and Apple Silicon (e.g., M1)

```
sherpa-ncnn fangjun$ file build-ios/openmp.xcframework/ios-arm64_x86_64-simulator/libomp.a
build-ios/openmp.xcframework/ios-arm64_x86_64-simulator/libomp.a: Mach-O universal binary with 2 architectures: [x86_64:current ar archive random library] [arm64:current ar archive random library]
build-ios/openmp.xcframework/ios-arm64_x86_64-simulator/libomp.a (for architecture x86_64): current ar archive random library
build-ios/openmp.xcframework/ios-arm64_x86_64-simulator/libomp.a (for architecture arm64): current ar archive random library

sherpa-ncnn fangjun$ lipo -info build-ios/openmp.xcframework/ios-arm64_x86_64-simulator/libomp.a
Architectures in the fat file: build-ios/openmp.xcframework/ios-arm64_x86_64-simulator/libomp.a are: x86_64 arm64

sherpa-ncnn fangjun$ file build-ios/openmp.xcframework/ios-arm64/libomp.a
build-ios/openmp.xcframework/ios-arm64/libomp.a: current ar archive random library

sherpa-ncnn fangjun$ lipo -info build-ios/openmp.xcframework/ios-arm64/libomp.a
Non-fat file: build-ios/openmp.xcframework/ios-arm64/libomp.a is architecture: arm64
```



Enter your password  
and click Next

Fig. 7.21: Screenshot for entering your password and click Next

### sherpa-ncnn.xcframework

```
sherpa-ncnn fangjun$ tree build-ios/sherpa-ncnn.xcframework/
build-ios/sherpa-ncnn.xcframework/
├── Headers
│   └── sherpa-ncnn
│       └── c-api
│           └── c-api.h
├── Info.plist
└── ios-arm64
    └── sherpa-ncnn.a
    └── ios-arm64_x86_64-simulator
        └── sherpa-ncnn.a

5 directories, 4 files
```

#### Explanation:

- **c-api.h:** The header file, which is copied from <https://github.com/k2-fsa/sherpa-ncnn/blob/master/sherpa-ncnn/c-api/c-api.h>
- **Info.plist:** A file that is dedicated for framework on macOS/iOS
- **ios-arm64/sherpa-ncnn.a:** A static library for iOS, e.g., iPhone
- **ios-arm64\_x86\_64-simulator/sherpa-ncnn.a:** A static library for simulators, including simulators for Intel chips and Apple Silicon (e.g., M1)

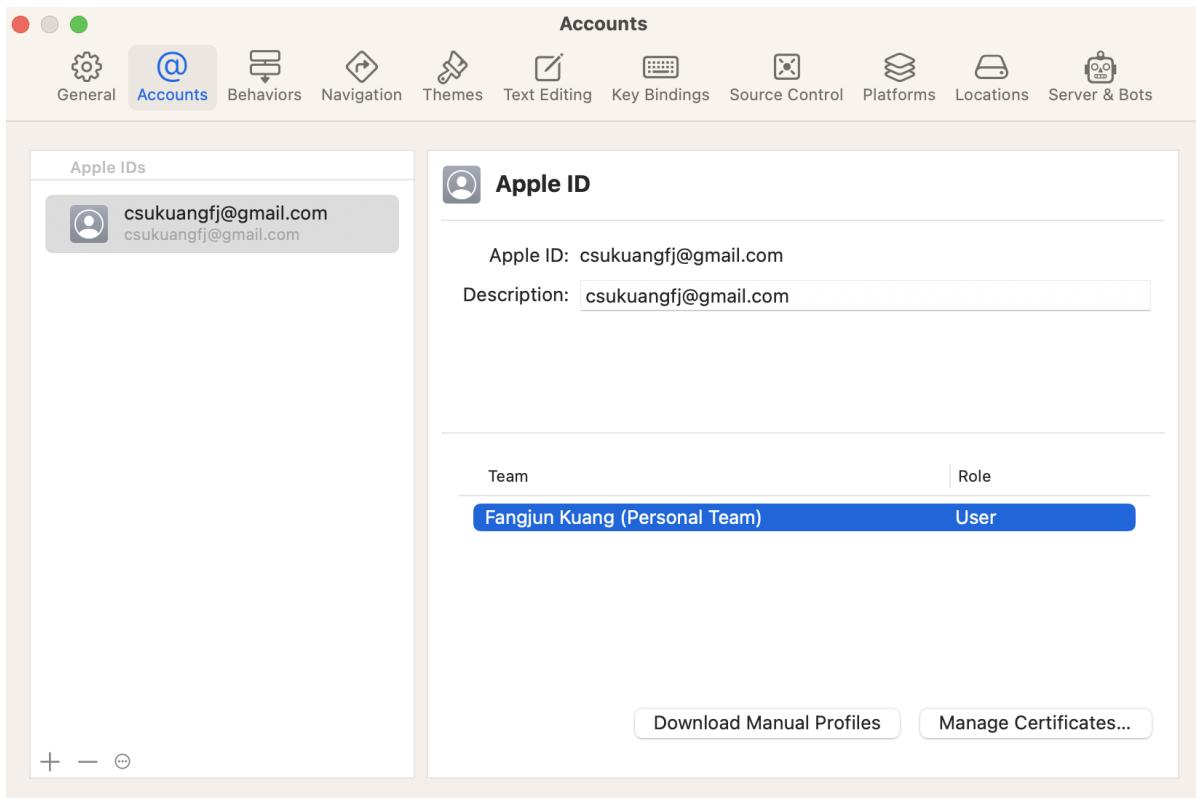


Fig. 7.22: Screenshot after adding your Apple ID

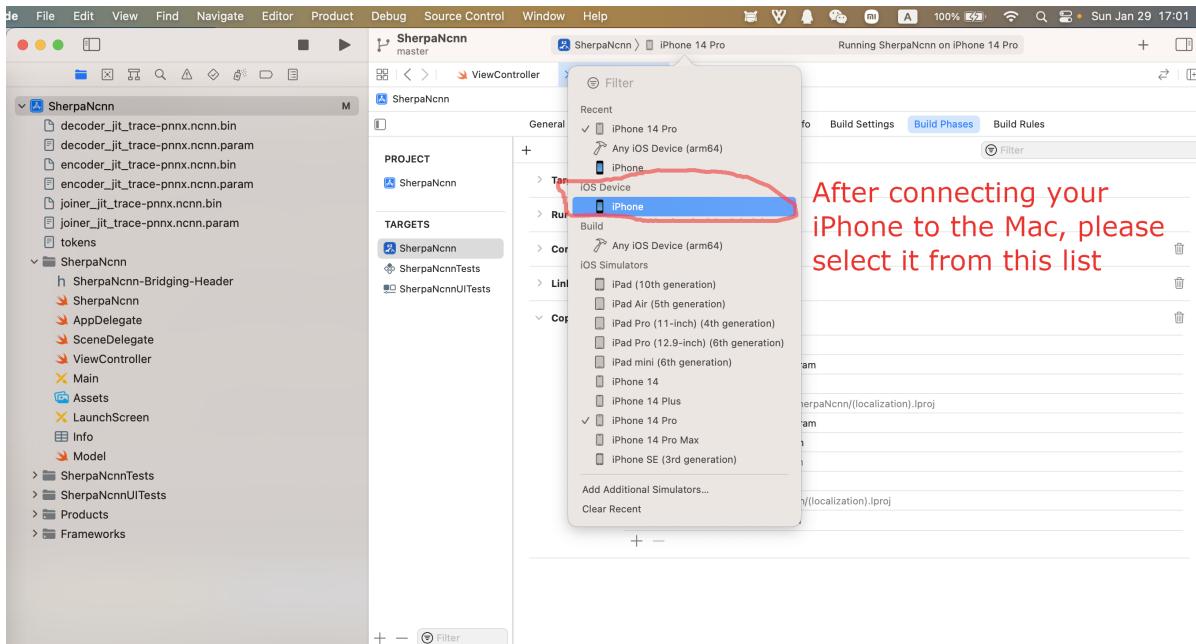


Fig. 7.23: Screenshot for selecting your device

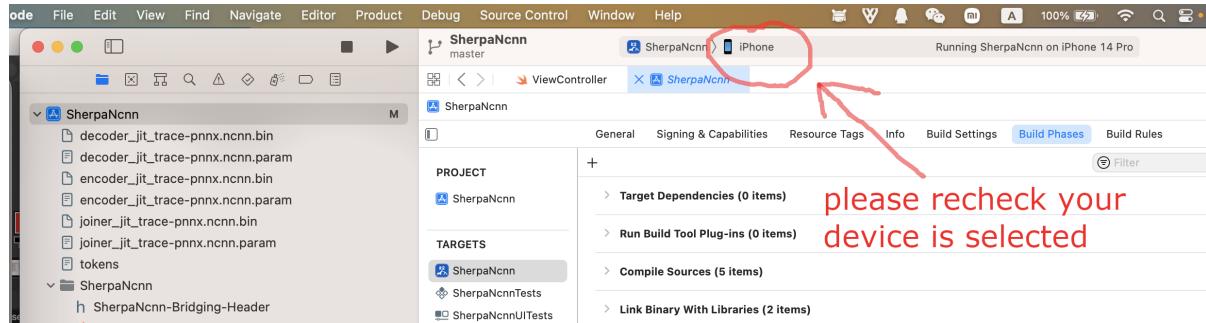


Fig. 7.24: Screenshot after selecting your device

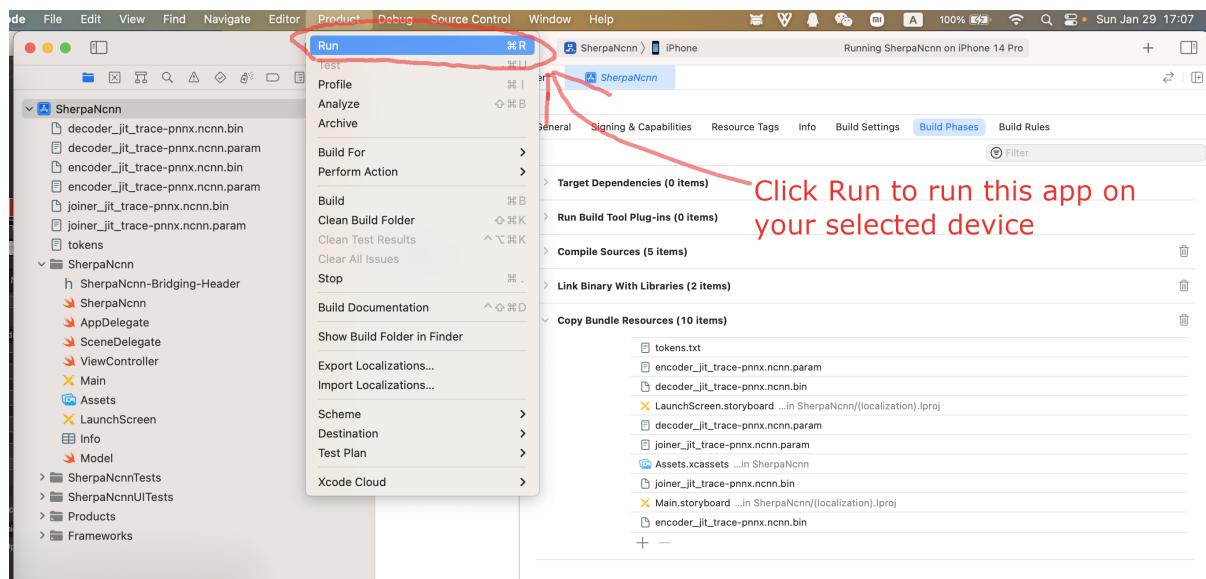


Fig. 7.25: Screenshot for selecting Product -> Run

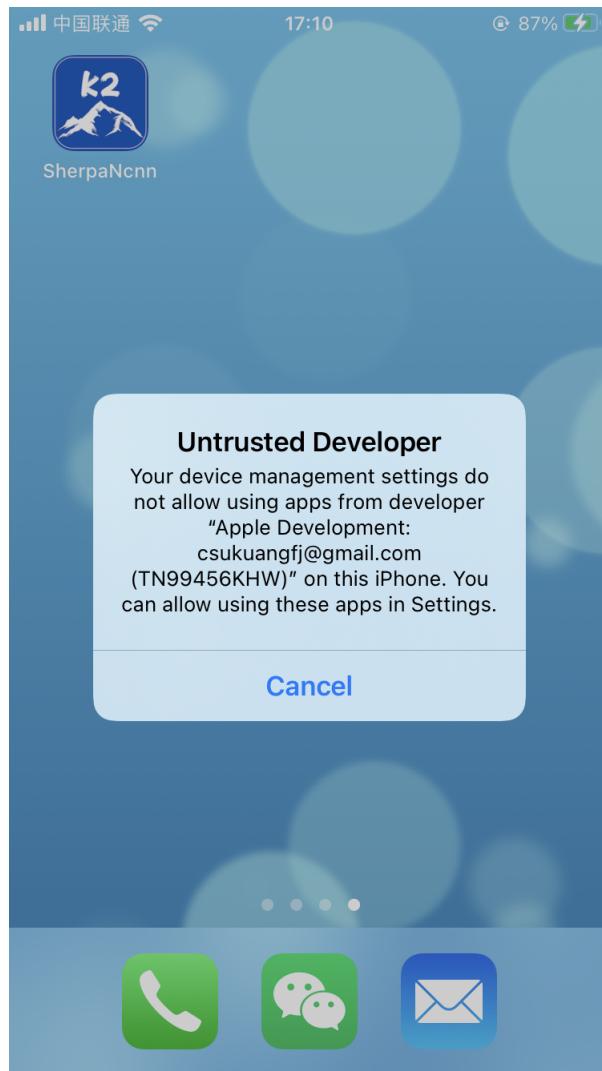


Fig. 7.26: Screenshot for running sherpa-ncnn on your device

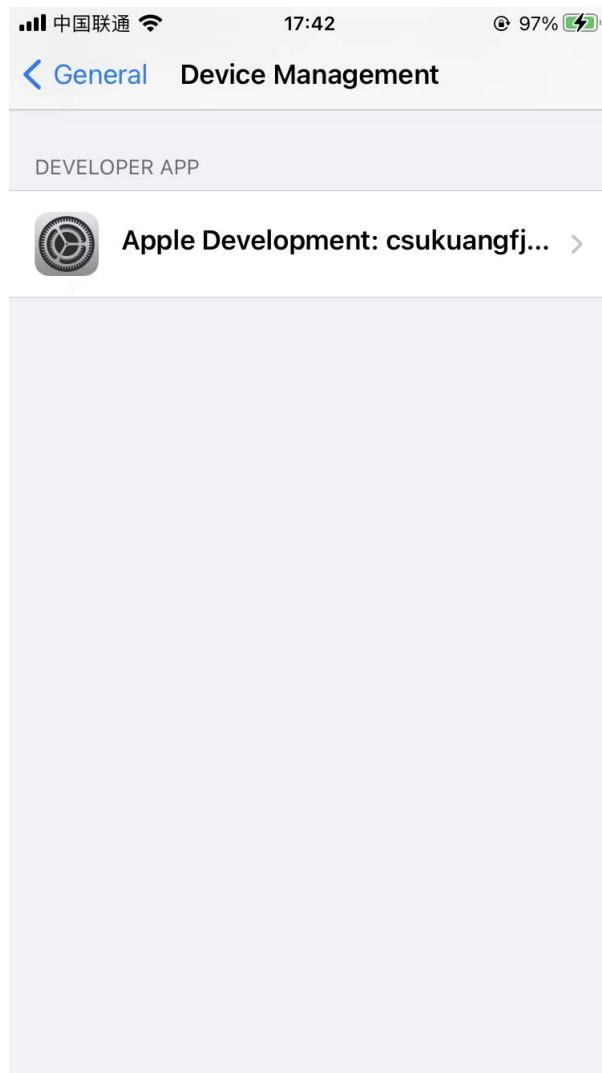


Fig. 7.27: Screenshot for selecting *Settings -> General -> Device Management* on your device

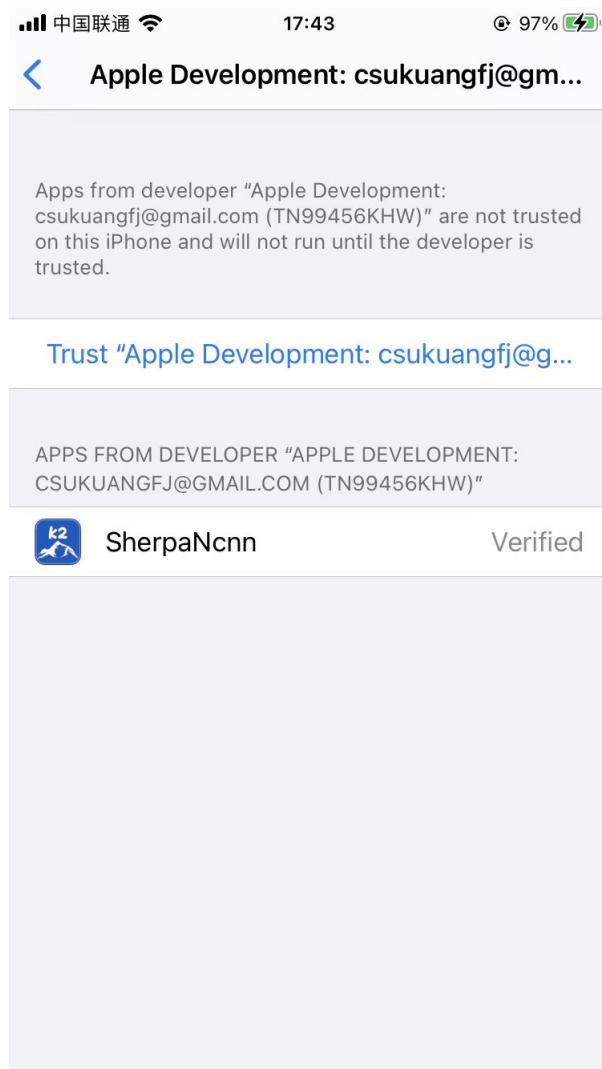


Fig. 7.28: Screenshot for “Trust “Apple Development: csukuangfj@g...””

中国联通 18:41 97%

ASR with Next-gen Kaldi

Press the Start button to run!

Click Start to  
run it!



Fig. 7.29: Screenshot for running `sherpa-ncnn` on iPhone

```

sherpa-ncnn fangjun$ file build-ios/sherpa-ncnn.xcframework/ios-arm64_x86_64-simulator/
sherpa-ncnn.a
build-ios/sherpa-ncnn.xcframework/ios-arm64_x86_64-simulator/sherpa-ncnn.a: Mach-O
universal binary with 2 architectures: [x86_64:current ar archive] [arm64]
build-ios/sherpa-ncnn.xcframework/ios-arm64_x86_64-simulator/sherpa-ncnn.a (for
architecture x86_64): current ar archive
build-ios/sherpa-ncnn.xcframework/ios-arm64_x86_64-simulator/sherpa-ncnn.a (for
architecture arm64): current ar archive

sherpa-ncnn fangjun$ lipo -info build-ios/sherpa-ncnn.xcframework/ios-arm64_x86_64-
simulator/sherpa-ncnn.a
Architectures in the fat file: build-ios/sherpa-ncnn.xcframework/ios-arm64_x86_64-
simulator/sherpa-ncnn.a are: x86_64 arm64

sherpa-ncnn fangjun$ file build-ios/sherpa-ncnn.xcframework/ios-arm64/sherpa-ncnn.a
build-ios/sherpa-ncnn.xcframework/ios-arm64/sherpa-ncnn.a: current ar archive

sherpa-ncnn fangjun$ lipo -info build-ios/sherpa-ncnn.xcframework/ios-arm64/sherpa-ncnn.a
Non-fat file: build-ios/sherpa-ncnn.xcframework/ios-arm64/sherpa-ncnn.a is architecture:
arm64

```

## How to use files generated by ./build-ios.sh in Xcode

In this section, we describe how to use `openmp.xcframework` and `sherpa-ncnn.xcframework` in Xcode.

The underlying implementation of `sherpa-ncnn` is in C++. It also provides C API.

To use C API in Xcode with Swift, we have to write a bridging header.

We provide a bridging header for you: `SherpaNcnn-Bridging-Header.h`. All you need is to add this file to your iOS project and click Build Settings -> Swift Compiler - General and set Objective-C Bridging Header to `$(PROJECT_DIR)/../../swift-api-examples/SherpaNcnn-Bridging-Header.h`. See the screenshot below for reference:

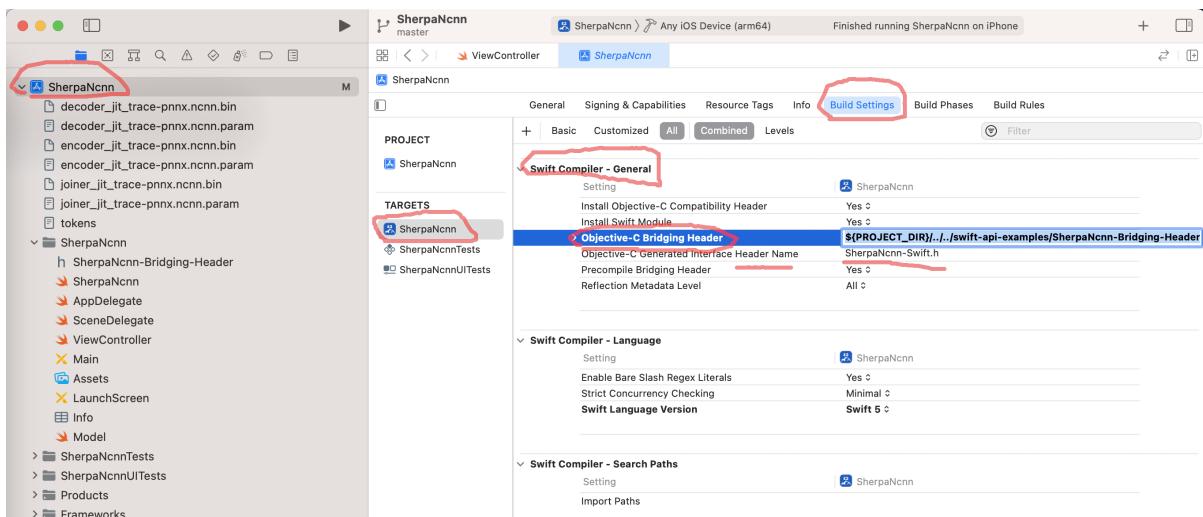


Fig. 7.30: Screenshot for setting the bridging header

We list the content of the bridging header below for reference:

```
#ifndef SWIFT_API_EXAMPLES_SHERPANCNN_BRIDGING_HEADER_H_
#define SWIFT_API_EXAMPLES_SHERPANCNN_BRIDGING_HEADER_H_

#import "sherpa-ncnn/c-api/c-api.h"

#endif // SWIFT_API_EXAMPLES_SHERPANCNN_BRIDGING_HEADER_H_
```

After adding the bridging header to your iOS project, Xcode will complain it cannot find `sherpa-ncnn/c-api/c-api.h`. The fix is to add the path `build-ios/sherpa-ncnn.xcframework/Headers` to Header Search Paths by changing Build Settings -> Search Paths -> Header Search Paths, as is shown in the following screenshot:

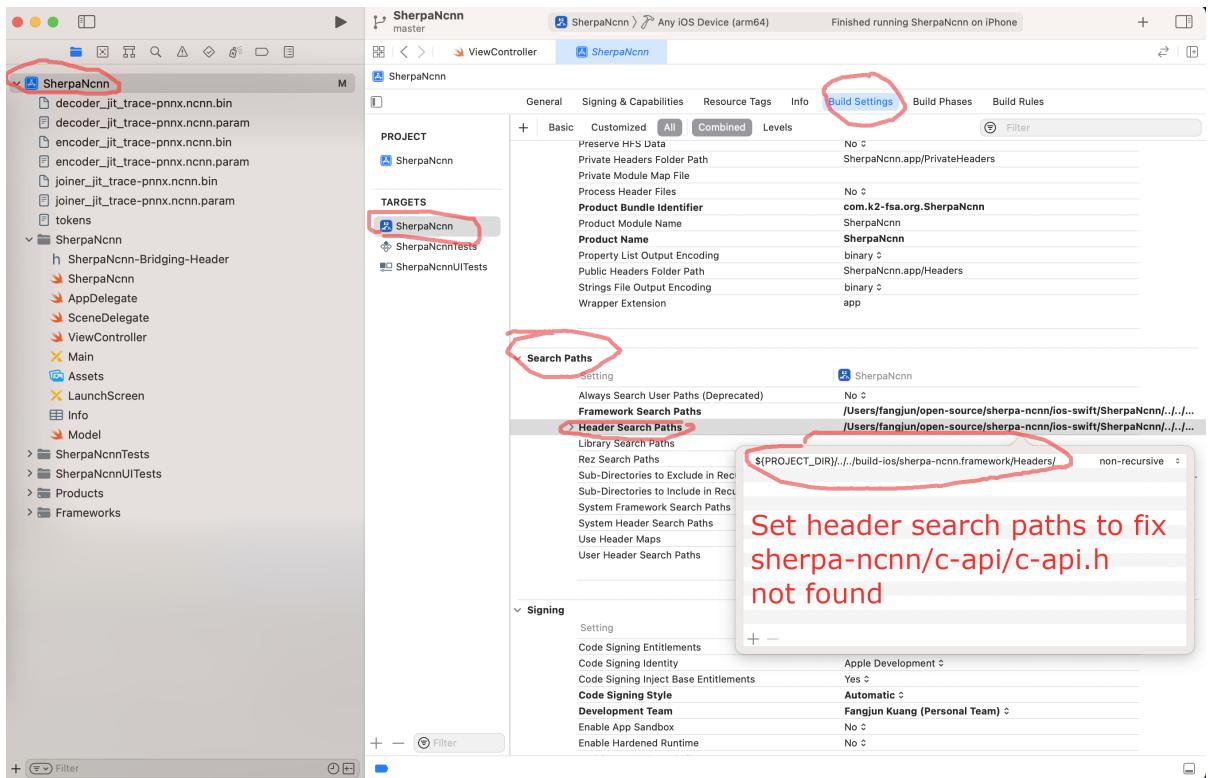


Fig. 7.31: Screenshot for setting the header search paths

**Hint:** Instead of using an absolute path, we use `$(PROJECT_DIR)/.../build-ios/sherpa-ncnn.xcframework/Headers/`

For instance, my `sherpa-ncnn` is downloaded to `/Users/fangjun/open-source/sherpa-ncnn` and the path to `sherpa-ncnn.xcframework` is `/Users/fangjun/open-source/sherpa-ncnn/build-ios/sherpa-ncnn.xcframework`.

The value of `PROJECT_DIR` is `/Users/fangjun/open-source/sherpa-ncnn/ios-swift/SherpaNcnn`, so we can use `$(PROJECT_DIR)/.../build-ios/sherpa-ncnn.xcframework/Headers/`.

Also note that `PROJECT_DIR` is a pre-defined variable in Xcode.

Please also add `SherpaNcnn.swift` to your iOS project, which is a utility to make it easier to access functions from the bridging header.

The next thing is to add `openmp.xcframework` and `sherpa-ncnn.xcframework` as dependencies to your iOS project. Select **Build Phases** -> **Link Binary with Libraries** and then click **+** to add `sherpa-ncnn.xcframework` and `openmp.xcframework`. See the screenshot below for reference:

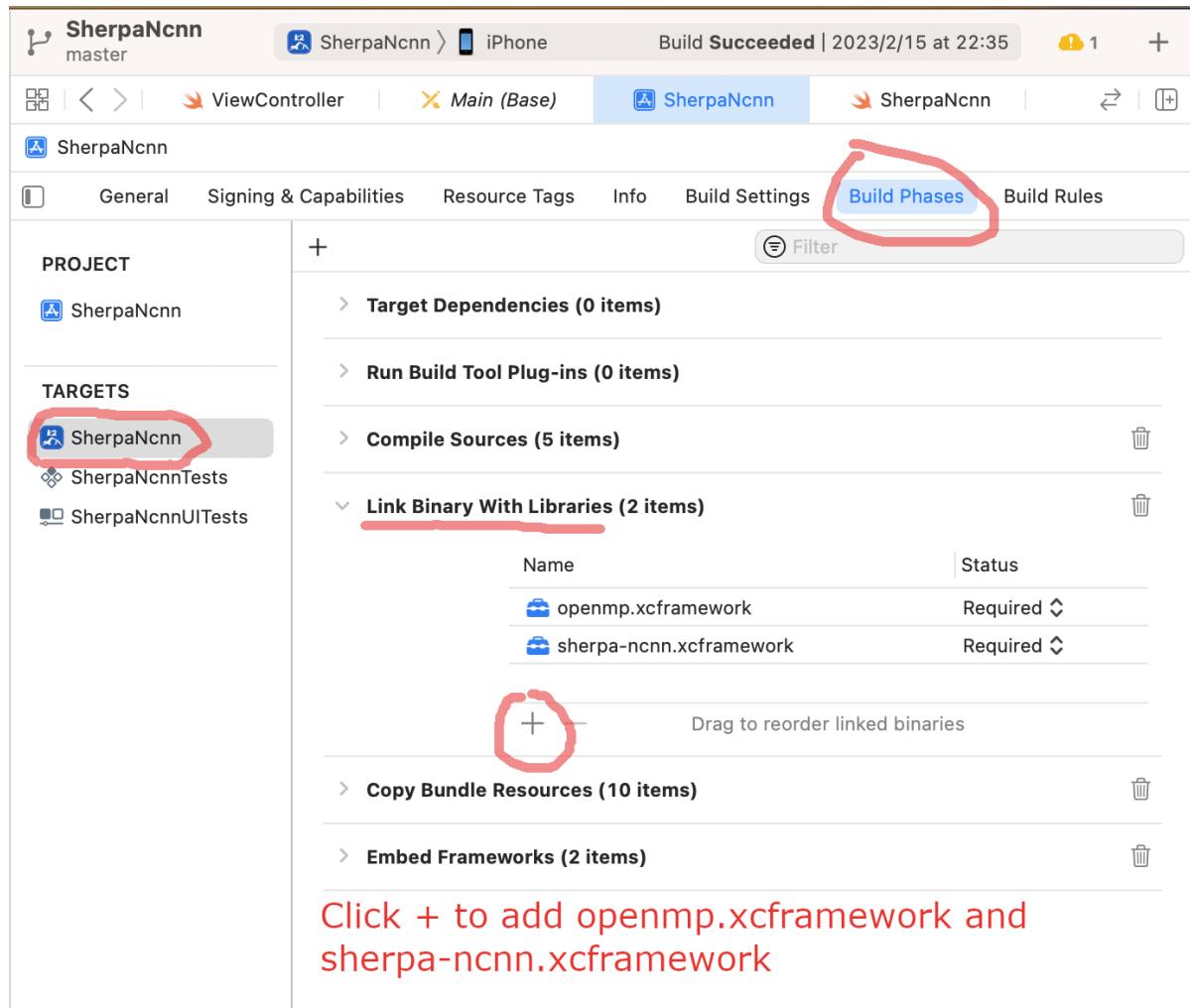


Fig. 7.32: Screenshot for adding a framework to your project

**Hint:** After clicking **+**, please select **Add Other...** -> **Add Files...**, and then add the path to `sherpa-ncnn.xcframework`.

Repeat the step for `openmp.xcframework`.

See the screenshot below for reference:

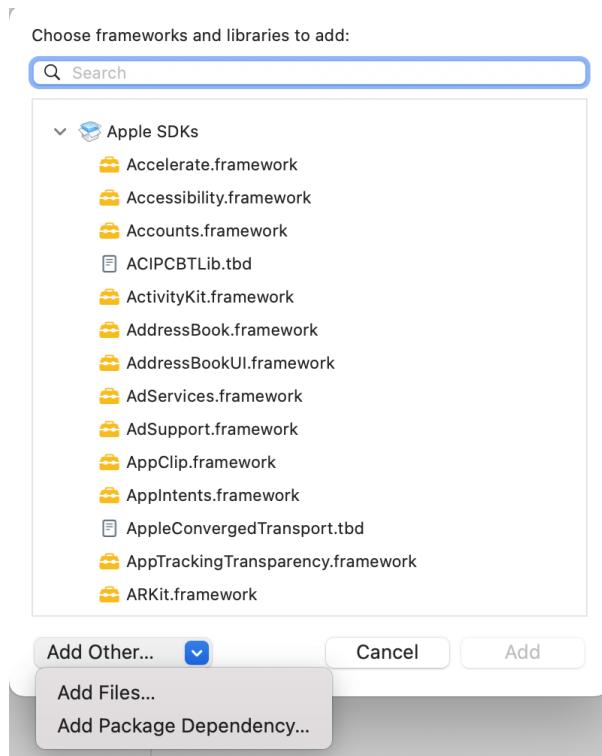


Fig. 7.33: Screenshot for adding a framework

---

One more thing you need to do after adding the framework is to setup the framework search path. Click **Build Settings** -> **Search Paths** -> **Framework Search Paths** and add the path to `build-ios/`. See the screenshot below:

If you encounter link errors about the C++ standard library, please add `-lc++` to link against `libc++` by clicking **Build Settings** -> **Linking** -> **Other Linker Flags** and adding `-lc++`. See the screenshot below for reference:

That is all you need to add `sherpa-ncnn` to your iOS project.

## 7.9 Pre-trained models

In this section, we describe how to download and use all available pre-trained models.

---

**Hint:** Please install `git-lfs` before you continue.

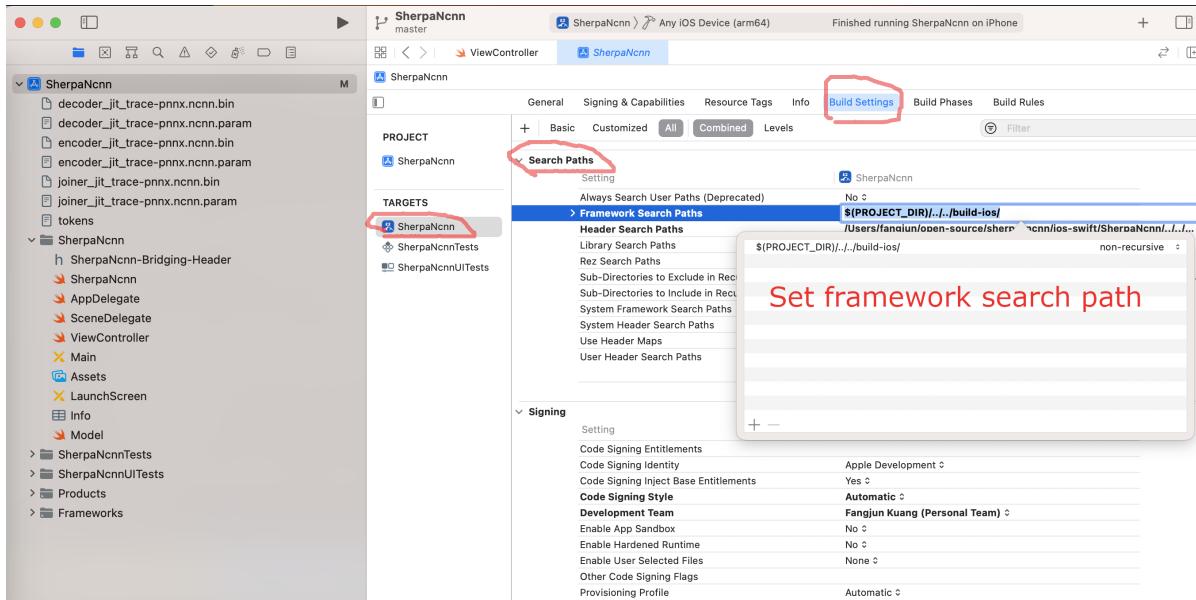
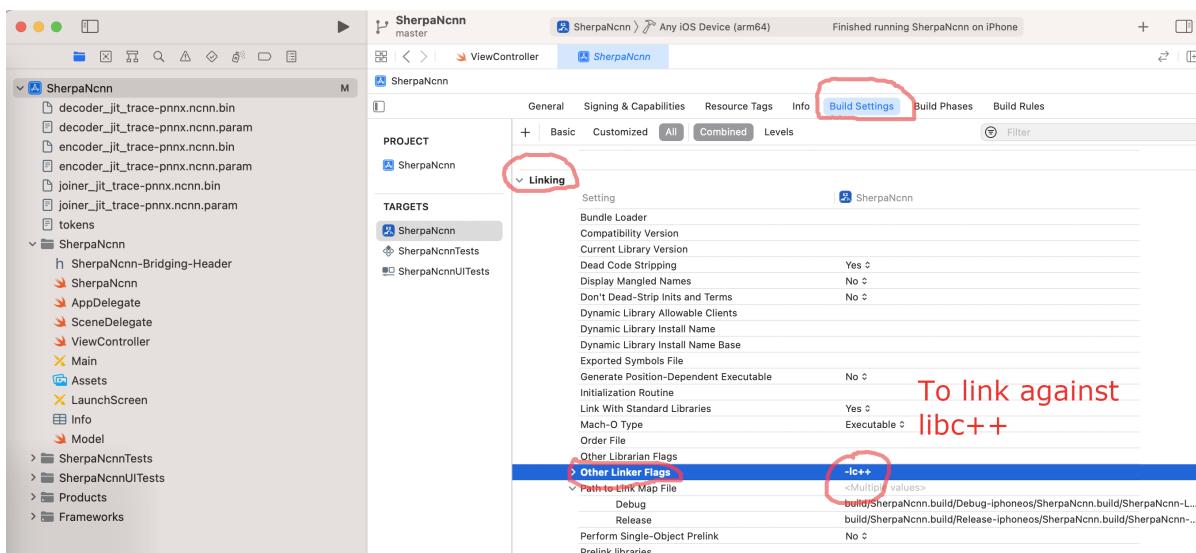


Fig. 7.34: Screenshot for setting framework search paths

Fig. 7.35: Screenshot for adding `-lc++` to linker flags

### 7.9.1 Small models

In this section, we list models with fewer parameters that are suitable for resource constrained embedded systems.

**Hint:** If you are using Raspberry Pi 4, this section is not so helpful for you since all models in `sherpa-ncnn` are able to run in real-time on it.

This page is especially useful for systems with less resource than Raspberry Pi 4.

- *marcoyang/sherpa-ncnn-streaming-zipformer-zh-14M-2023-02-23* (Chinese)
  - *marcoyang/sherpa-ncnn-streaming-zipformer-20M-2023-02-17* (English)
  - *marcoyang/sherpa-ncnn-conv-emformer-transducer-small-2023-01-09* (English)
  - *csukuangfj/sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16* (Bilingual, Chinese + English)
  - *marcoyang/sherpa-ncnn-lstm-transducer-small-2023-02-13* (Bilingual, Chinese + English)

## 7.9.2 Zipformer-transducer-based Models

**Hint:** Please refer to [Installation](#) to install `sherpa-ncnn` before you read this section.

marcoyang/sherpa-ncnn-streaming-zipformer-zh-14M-2023-02-23 (Chinese)

This model is a streaming Zipformer model which has around 14 million parameters. It is trained on the [WenetSpeech](#) corpus so it supports only Chinese.

You can find the training code at [https://github.com/k2-fsa/icefall/tree/master/egs/librispeech/ASR/pruned\\_transducer\\_stateless7\\_streaming](https://github.com/k2-fsa/icefall/tree/master/egs/librispeech/ASR/pruned_transducer_stateless7_streaming)

In the following, we describe how to download it and use it with `sherpa-ncnn`.

## Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-ncnn  
  
wget https://github.com/k2-fsa/sherpa-ncnn/releases/download/models/sherpa-ncnn-  
→streaming-zipformer-zh-14M-2023-02-23.tar.bz2  
tar xvf sherpa-ncnn-streaming-zipformer-zh-14M-2023-02-23.tar.bz2
```

## Decode a single wave file

**Hint:** It supports decoding only wave files with a single channel and the sampling rate should be 16 kHz.

```
cd /path/to/sherpa-ncnn

for method in greedy_search modified_beam_search; do
    ./build/bin/sherpa-ncnn \
        ./sherpa-ncnn-streaming-zipformer-zh-14M-2023-02-23/tokens.txt \
        ./sherpa-ncnn-streaming-zipformer-zh-14M-2023-02-23/encoder_jit_trace-pnnx.ncnn.
    ↪ param \
        ./sherpa-ncnn-streaming-zipformer-zh-14M-2023-02-23/encoder_jit_trace-pnnx.ncnn.bin \
        ./sherpa-ncnn-streaming-zipformer-zh-14M-2023-02-23/decoder_jit_trace-pnnx.ncnn.
    ↪ param \
        ./sherpa-ncnn-streaming-zipformer-zh-14M-2023-02-23/decoder_jit_trace-pnnx.ncnn.bin \
        ./sherpa-ncnn-streaming-zipformer-zh-14M-2023-02-23/joiner_jit_trace-pnnx.ncnn.param
    ↪ \
        ./sherpa-ncnn-streaming-zipformer-zh-14M-2023-02-23/joiner_jit_trace-pnnx.ncnn.bin \
        ./sherpa-ncnn-streaming-zipformer-zh-14M-2023-02-23/test_wavs/0.wav \
    2 \
    $method
done
```

You should see the following output:

```
Disable fp16 for Zipformer encoder
Don't Use GPU. has_gpu: 0, config.use_vulkan_compute: 1
ModelConfig(encoder_param="pruned_transducer_stateless7_streaming/exp-small-L/encoder_
↪ jit_trace-pnnx.ncnn.param", encoder_bin="pruned_transducer_stateless7_streaming/exp-
↪ small-L/encoder_jit_trace-pnnx.ncnn.bin", decoder_param="pruned_transducer_stateless7_
↪ streaming/exp-small-L/decoder_jit_trace-pnnx.ncnn.param", decoder_bin="pruned_
↪ transducer_stateless7_streaming/exp-small-L/decoder_jit_trace-pnnx.ncnn.bin", joiner_
↪ param="pruned_transducer_stateless7_streaming/exp-small-L/joiner_jit_trace-pnnx.ncnn.
↪ param", joiner_bin="pruned_transducer_stateless7_streaming/exp-small-L/joiner_jit_
↪ trace-pnnx.ncnn.bin", tokens="data/lang_char/tokens.txt", encoder num_threads=4,_
↪ decoder num_threads=4, joiner num_threads=4)
DecoderConfig(method="modified_beam_search", num_active_paths=4, enable_endpoint=False,_
↪ endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_
↪ trailing_silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_
↪ nonsilence=True, min_trailing_silence=1.4, min_utterance_length=0),_
↪ rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_silence=0, min_
↪ utterance_length=20)))
wav filename: ./test_wavs_zh/0.wav
wav duration (s): 5.6115
Started!
Done!
Recognition result for ./test_wavs_zh/0.wav

Elapsed seconds: 0.678 s
Real time factor (RTF): 0.678 / 5.611 = 0.121
```

(continues on next page)

(continued from previous page)

```

Disable fp16 for Zipformer encoder
Don't Use GPU. has_gpu: 0, config.use_vulkan_compute: 1
ModelConfig(encoder_param="pruned_transducer_stateless7_streaming/exp-small-L/encoder_
↪jit_trace-pnnx.ncnn.param", encoder_bin="pruned_transducer_stateless7_streaming/exp-
↪small-L/encoder_jit_trace-pnnx.ncnn.bin", decoder_param="pruned_transducer_stateless7_
↪streaming/exp-small-L/decoder_jit_trace-pnnx.ncnn.param", decoder_bin="pruned_
↪transducer_stateless7_streaming/exp-small-L/decoder_jit_trace-pnnx.ncnn.bin", joiner_
↪param="pruned_transducer_stateless7_streaming/exp-small-L/joiner_jit_trace-pnnx.ncnn.
↪param", joiner_bin="pruned_transducer_stateless7_streaming/exp-small-L/joiner_jit_
↪trace-pnnx.ncnn.bin", tokens="data/lang_char/tokens.txt", encoder num_threads=4,_
↪decoder num_threads=4, joiner num_threads=4)
DecoderConfig(method="modified_beam_search", num_active_paths=4, enable_endpoint=False,_
↪endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_
↪trailing_silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_
↪nonsilence=True, min_trailing_silence=1.4, min_utterance_length=0),_
↪rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_silence=0, min_
↪utterance_length=20)))
wav filename: ./test_wavs_zh/1.wav
wav duration (s): 5.15306
Started!
Done!
Recognition result for ./test_wavs_zh/1.wav

Elapsed seconds: 0.676 s
Real time factor (RTF): 0.676 / 5.153 = 0.131

Disable fp16 for Zipformer encoder
Don't Use GPU. has_gpu: 0, config.use_vulkan_compute: 1
ModelConfig(encoder_param="pruned_transducer_stateless7_streaming/exp-small-L/encoder_
↪jit_trace-pnnx.ncnn.param", encoder_bin="pruned_transducer_stateless7_streaming/exp-
↪small-L/encoder_jit_trace-pnnx.ncnn.bin", decoder_param="pruned_transducer_stateless7_
↪streaming/exp-small-L/decoder_jit_trace-pnnx.ncnn.param", decoder_bin="pruned_
↪transducer_stateless7_streaming/exp-small-L/decoder_jit_trace-pnnx.ncnn.bin", joiner_
↪param="pruned_transducer_stateless7_streaming/exp-small-L/joiner_jit_trace-pnnx.ncnn.
↪param", joiner_bin="pruned_transducer_stateless7_streaming/exp-small-L/joiner_jit_
↪trace-pnnx.ncnn.bin", tokens="data/lang_char/tokens.txt", encoder num_threads=4,_
↪decoder num_threads=4, joiner num_threads=4)
DecoderConfig(method="modified_beam_search", num_active_paths=4, enable_endpoint=False,_
↪endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_
↪trailing_silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_
↪nonsilence=True, min_trailing_silence=1.4, min_utterance_length=0),_
↪rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_silence=0, min_
↪utterance_length=20)))
wav filename: ./test_wavs_zh/2.wav
wav duration (s): 4.52431
Started!
Done!
Recognition result for ./test_wavs_zh/2.wav

Elapsed seconds: 0.592 s
Real time factor (RTF): 0.592 / 4.524 = 0.131

```

---

**Note:** Please use `./build/bin/Release/sherpa-ncnn.exe` for Windows.

---

**Caution:** If you use Windows and get encoding issues, please run:

CHCP 65001

in your commandline.

## Real-time speech recognition from a microphone

```
cd /path/to/sherpa-ncnn
./build/bin/sherpa-ncnn-microphone \
  ./sherpa-ncnn-streaming-zipformer-zh-14M-2023-02-23/tokens.txt \
  ./sherpa-ncnn-streaming-zipformer-zh-14M-2023-02-23/encoder_jit_trace-pnnx.ncnn.param \
  ./sherpa-ncnn-streaming-zipformer-zh-14M-2023-02-23/encoder_jit_trace-pnnx.ncnn.bin \
  ./sherpa-ncnn-streaming-zipformer-zh-14M-2023-02-23/decoder_jit_trace-pnnx.ncnn.param \
  ./sherpa-ncnn-streaming-zipformer-zh-14M-2023-02-23/decoder_jit_trace-pnnx.ncnn.bin \
  ./sherpa-ncnn-streaming-zipformer-zh-14M-2023-02-23/joiner_jit_trace-pnnx.ncnn.param \
  ./sherpa-ncnn-streaming-zipformer-zh-14M-2023-02-23/joiner_jit_trace-pnnx.ncnn.bin \
  2 \
  greedy_search
```

---

**Hint:** If your system is Linux (including embedded Linux), you can also use `sherpa-ncnn-alsa` to do real-time speech recognition with your microphone if `sherpa-ncnn-microphone` does not work for you.

---

## marcoyang/sherpa-ncnn-streaming-zipformer-20M-2023-02-17 (English)

This model is a streaming Zipformer model converted from

<https://huggingface.co/desh2608/icefall-asr-librispeech-pruned-transducer-stateless7-streaming-small>

which has around 20 million parameters. It is trained on the LibriSpeech corpus so it supports only English. The word-error-rates(%) on `test-clean` is 3.88.

You can find the training code at [https://github.com/k2-fsa/icefall/tree/master/egs/librispeech/ASR/pruned\\_transducer\\_stateless7\\_streaming](https://github.com/k2-fsa/icefall/tree/master/egs/librispeech/ASR/pruned_transducer_stateless7_streaming)

In the following, we describe how to download it and use it with `sherpa-ncnn`.

## Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-ncnn
wget https://github.com/k2-fsa/sherpa-ncnn/releases/download/models/sherpa-ncnn-
tar streaming-zipformer-20M-2023-02-17.tar.bz2
tar xvf sherpa-ncnn-streaming-zipformer-20M-2023-02-17.tar.bz2
```

## Decode a single wave file

---

**Hint:** It supports decoding only wave files with a single channel and the sampling rate should be 16 kHz.

---

```
cd /path/to/sherpa-ncnn
for method in greedy_search modified_beam_search; do
  ./build/bin/sherpa-ncnn \
    ./sherpa-ncnn-streaming-zipformer-20M-2023-02-17/tokens.txt \
    ./sherpa-ncnn-streaming-zipformer-20M-2023-02-17/encoder_jit_trace-pnnx.ncnn.param \
    ./sherpa-ncnn-streaming-zipformer-20M-2023-02-17/encoder_jit_trace-pnnx.ncnn.bin \
    ./sherpa-ncnn-streaming-zipformer-20M-2023-02-17/decoder_jit_trace-pnnx.ncnn.param \
    ./sherpa-ncnn-streaming-zipformer-20M-2023-02-17/decoder_jit_trace-pnnx.ncnn.bin \
    ./sherpa-ncnn-streaming-zipformer-20M-2023-02-17/joiner_jit_trace-pnnx.ncnn.param \
    ./sherpa-ncnn-streaming-zipformer-20M-2023-02-17/joiner_jit_trace-pnnx.ncnn.bin \
    ./sherpa-ncnn-streaming-zipformer-20M-2023-02-17/test_wavs/0.wav \
  2 \
  $method
done
```

You should see the following output:

```
Disable fp16 for Zipformer encoder
Don't Use GPU. has_gpu: 0, config.use_vulkan_compute: 1
ModelConfig(encoder_param="./sherpa-ncnn-streaming-zipformer-20M-2023-02-17/encoder_jit_
trace-pnnx.ncnn.param", encoder_bin="./sherpa-ncnn-streaming-zipformer-20M-2023-02-17/
encoder_jit_trace-pnnx.ncnn.bin", decoder_param="./sherpa-ncnn-streaming-zipformer-20M-
2023-02-17/decoder_jit_trace-pnnx.ncnn.param", decoder_bin="./sherpa-ncnn-streaming-
zipformer-20M-2023-02-17/decoder_jit_trace-pnnx.ncnn.bin", joiner_param="./sherpa-ncnn-
streaming-zipformer-20M-2023-02-17/joiner_jit_trace-pnnx.ncnn.param", joiner_bin="./
sherpa-ncnn-streaming-zipformer-20M-2023-02-17/joiner_jit_trace-pnnx.ncnn.bin", tokens=
"./sherpa-ncnn-streaming-zipformer-20M-2023-02-17/tokens.txt", encoder_num_threads=2,_
decoder_num_threads=2, joiner_num_threads=2)
DecoderConfig(method="greedy_search", num_active_paths=4, enable_endpoint=False,_
endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_
trailing_silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_
nonsilence=True, min_trailing_silence=1.4, min_utterance_length=0),_
rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_silence=0, min_
utterance_length=20)))
wav filename: ./sherpa-ncnn-streaming-zipformer-20M-2023-02-17/test_wavs/0.wav
```

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```
wav duration (s): 6.625
Started!
Done!
Recognition result for ./sherpa-ncnn-streaming-zipformer-20M-2023-02-17/test_wavs/0.wav
  AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID
  ↵ QUARTER OF THE BRAFFLELS
Elapsed seconds: 0.472 s
Real time factor (RTF): 0.472 / 6.625 = 0.071
```

---

**Note:** Please use `./build/bin/Release/sherpa-ncnn.exe` for Windows.

---

### Real-time speech recognition from a microphone

```
cd /path/to/sherpa-ncnn

./build/bin/sherpa-ncnn-microphone \
  ./sherpa-ncnn-streaming-zipformer-20M-2023-02-17/tokens.txt \
  ./sherpa-ncnn-streaming-zipformer-20M-2023-02-17/encoder_jit_trace-pnnx.ncnn.param \
  ./sherpa-ncnn-streaming-zipformer-20M-2023-02-17/encoder_jit_trace-pnnx.ncnn.bin \
  ./sherpa-ncnn-streaming-zipformer-20M-2023-02-17/decoder_jit_trace-pnnx.ncnn.param \
  ./sherpa-ncnn-streaming-zipformer-20M-2023-02-17/decoder_jit_trace-pnnx.ncnn.bin \
  ./sherpa-ncnn-streaming-zipformer-20M-2023-02-17/joiner_jit_trace-pnnx.ncnn.param \
  ./sherpa-ncnn-streaming-zipformer-20M-2023-02-17/joiner_jit_trace-pnnx.ncnn.bin \
  2 \
  greedy_search
```

---

**Hint:** If your system is Linux (including embedded Linux), you can also use `sherpa-ncnn-alsa` to do real-time speech recognition with your microphone if `sherpa-ncnn-microphone` does not work for you.

---

### csukuangfj/sherpa-ncnn-streaming-zipformer-en-2023-02-13 (English)

This model is converted from

<https://huggingface.co/Zengwei/icefall-asr-librispeech-pruned-transducer-stateless7-streaming-2022-12-29>

which supports only English as it is trained on the LibriSpeech corpus.

You can find the training code at

[https://github.com/k2-fsa/icefall/tree/master/egs/librispeech/ASR/pruned\\_transducer\\_stateless7\\_streaming](https://github.com/k2-fsa/icefall/tree/master/egs/librispeech/ASR/pruned_transducer_stateless7_streaming)

In the following, we describe how to download it and use it with `sherpa-ncnn`.

## Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-ncnn

wget https://github.com/k2-fsa/sherpa-ncnn/releases/download/models/sherpa-ncnn-
˓→streaming-zipformer-en-2023-02-13.tar.bz2
tar xvf sherpa-ncnn-streaming-zipformer-en-2023-02-13.tar.bz2
```

## Decode a single wave file

---

**Hint:** It supports decoding only wave files with a single channel and the sampling rate should be 16 kHz.

---

```
cd /path/to/sherpa-ncnn

for method in greedy_search modified_beam_search; do
./build/bin/sherpa-ncnn \
./sherpa-ncnn-streaming-zipformer-en-2023-02-13/tokens.txt \
./sherpa-ncnn-streaming-zipformer-en-2023-02-13/encoder_jit_trace-pnnx.ncnn.param \
./sherpa-ncnn-streaming-zipformer-en-2023-02-13/encoder_jit_trace-pnnx.ncnn.bin \
./sherpa-ncnn-streaming-zipformer-en-2023-02-13/decoder_jit_trace-pnnx.ncnn.param \
./sherpa-ncnn-streaming-zipformer-en-2023-02-13/decoder_jit_trace-pnnx.ncnn.bin \
./sherpa-ncnn-streaming-zipformer-en-2023-02-13/joiner_jit_trace-pnnx.ncnn.param \
./sherpa-ncnn-streaming-zipformer-en-2023-02-13/joiner_jit_trace-pnnx.ncnn.bin \
./sherpa-ncnn-streaming-zipformer-en-2023-02-13/test_wavs/1221-135766-0002.wav \
2 \
$method
done
```

You should see the following output:

```
ModelConfig(encoder_param="./sherpa-ncnn-streaming-zipformer-en-2023-02-13/encoder_jit-
˓→trace-pnnx.ncnn.param", encoder_bin="./sherpa-ncnn-streaming-zipformer-en-2023-02-13/
˓→encoder_jit_trace-pnnx.ncnn.bin", decoder_param="./sherpa-ncnn-streaming-zipformer-en-
˓→2023-02-13/decoder_jit_trace-pnnx.ncnn.param", decoder_bin="./sherpa-ncnn-streaming-
˓→zipformer-en-2023-02-13/decoder_jit_trace-pnnx.ncnn.bin", joiner_param="./sherpa-ncnn-
˓→streaming-zipformer-en-2023-02-13/joiner_jit_trace-pnnx.ncnn.param", joiner_bin="./
˓→sherpa-ncnn-streaming-zipformer-en-2023-02-13/joiner_jit_trace-pnnx.ncnn.bin", tokens=
˓→"./sherpa-ncnn-streaming-zipformer-en-2023-02-13/tokens.txt", encoder_num_threads=2, \
˓→decoder_num_threads=2, joiner_num_threads=2)
DecoderConfig(method="greedy_search", num_active_paths=4, enable_endpoint=False, \
˓→endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_
˓→trailing_silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_
˓→nonsilence=True, min_trailing_silence=1.4, min_utterance_length=0), \
˓→rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_silence=0, min_
˓→utterance_length=20)))
wav filename: ./sherpa-ncnn-streaming-zipformer-en-2023-02-13/test_wavs/1221-135766-0002.
˓→wav
wav duration (s): 4.825
```

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```

Started!
Done!
Recognition result for ./sherpa-ncnn-streaming-zipformer-en-2023-02-13/test_wavs/1221-
↪135766-0002.wav
  YET THESE THOUGHTS AFFECTED HESTER PRYNNE LESS WITH HOPE THAN APPREHENSION
Elapsed seconds: 0.569 s
Real time factor (RTF): 0.569 / 4.825 = 0.118
ModelConfig(encoder_param=".sherpa-ncnn-streaming-zipformer-en-2023-02-13/encoder_jit_",
↪trace-pnnx.ncnn.param", encoder_bin=".sherpa-ncnn-streaming-zipformer-en-2023-02-13/
↪encoder_jit_trace-pnnx.ncnn.bin", decoder_param=".sherpa-ncnn-streaming-zipformer-en-
↪2023-02-13/decoder_jit_trace-pnnx.ncnn.param", decoder_bin=".sherpa-ncnn-streaming-
↪zipformer-en-2023-02-13/decoder_jit_trace-pnnx.ncnn.bin", joiner_param=".sherpa-ncnn-
↪streaming-zipformer-en-2023-02-13/joiner_jit_trace-pnnx.ncnn.param", joiner_bin="./
↪sherpa-ncnn-streaming-zipformer-en-2023-02-13/joiner_jit_trace-pnnx.ncnn.bin", tokens=
↪"./sherpa-ncnn-streaming-zipformer-en-2023-02-13/tokens.txt", encoder num_threads=2,_
↪decoder num_threads=2, joiner num_threads=2)
DecoderConfig(method="modified_beam_search", num_active_paths=4, enable_endpoint=False,_
↪endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_
↪trailing_silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_
↪nonsilence=True, min_trailing_silence=1.4, min_utterance_length=0),_
↪rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_silence=0, min_
↪utterance_length=20)))
wav filename: ./sherpa-ncnn-streaming-zipformer-en-2023-02-13/test_wavs/1221-135766-0002.
↪wav
wav duration (s): 4.825
Started!
Done!
Recognition result for ./sherpa-ncnn-streaming-zipformer-en-2023-02-13/test_wavs/1221-
↪135766-0002.wav
  YET THESE THOUGHTS AFFECTED HESTER PRYNNE LESS WITH HOPE THAN APPREHENSION
Elapsed seconds: 0.554 s
Real time factor (RTF): 0.554 / 4.825 = 0.115

```

**Note:** Please use `./build/bin/Release/sherpa-ncnn.exe` for Windows.

### Real-time speech recognition from a microphone

```

cd /path/to/sherpa-ncnn

./build/bin/sherpa-ncnn-microphone \
./sherpa-ncnn-streaming-zipformer-en-2023-02-13/tokens.txt \
./sherpa-ncnn-streaming-zipformer-en-2023-02-13/encoder_jit_trace-pnnx.ncnn.param \
./sherpa-ncnn-streaming-zipformer-en-2023-02-13/encoder_jit_trace-pnnx.ncnn.bin \
./sherpa-ncnn-streaming-zipformer-en-2023-02-13/decoder_jit_trace-pnnx.ncnn.param \
./sherpa-ncnn-streaming-zipformer-en-2023-02-13/decoder_jit_trace-pnnx.ncnn.bin \
./sherpa-ncnn-streaming-zipformer-en-2023-02-13/joiner_jit_trace-pnnx.ncnn.param \
./sherpa-ncnn-streaming-zipformer-en-2023-02-13/joiner_jit_trace-pnnx.ncnn.bin \
2 \
greedy_search

```

---

**Hint:** If your system is Linux (including embedded Linux), you can also use *sherpa-ncnn-alsa* to do real-time speech recognition with your microphone if *sherpa-ncnn-microphone* does not work for you.

---

## [csukuangfj/sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13 \(Bilingual, Chinese + English\)](#)

This model is converted from

<https://huggingface.co/pfluo/k2fsa-zipformer-chinese-english-mixed>

which supports both Chinese and English. The model is contributed by the community and is trained on tens of thousands of some internal dataset.

In the following, we describe how to download it and use it with *sherpa-ncnn*.

### Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-ncnn
wget https://github.com/k2-fsa/sherpa-ncnn/releases/download/models/sherpa-ncnn-
˓→streaming-zipformer-bilingual-zh-en-2023-02-13.tar.bz2
tar xvf sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13.tar.bz2
```

### Decode a single wave file

---

**Hint:** It supports decoding only wave files with a single channel and the sampling rate should be 16 kHz.

---

```
cd /path/to/sherpa-ncnn

for method in greedy_search modified_beam_search; do
  ./build/bin/sherpa-ncnn \
    ./sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13/tokens.txt \
    ./sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13/encoder_jit_trace-pnnx.
  ↵ncnn.param \
    ./sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13/encoder_jit_trace-pnnx.
  ↵ncnn.bin \
    ./sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13/decoder_jit_trace-pnnx.
  ↵ncnn.param \
    ./sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13/decoder_jit_trace-pnnx.
  ↵ncnn.bin \
    ./sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13/joiner_jit_trace-pnnx.
  ↵ncnn.param \
    ./sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13/joiner_jit_trace-pnnx.
  ↵ncnn.bin \
    ./sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13/test_wavs/1.wav \
  2 \
```

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\$method  
**done**

You should see the following output:

```
ModelConfig(encoder_param=".sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13/",  
    encoder_jit_trace_pnnx.ncnn.param", encoder_bin=".sherpa-ncnn-streaming-zipformer-  
    bilingual-zh-en-2023-02-13/encoder_jit_trace_pnnx.ncnn.bin", decoder_param=".sherpa-  
    ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13/decoder_jit_trace_pnnx.ncnn.param",  
    decoder_bin=".sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13/decoder_jit-  
    trace_pnnx.ncnn.bin", joiner_param=".sherpa-ncnn-streaming-zipformer-bilingual-zh-en-  
    2023-02-13/joiner_jit_trace_pnnx.ncnn.param", joiner_bin=".sherpa-ncnn-streaming-  
    zipformer-bilingual-zh-en-2023-02-13/joiner_jit_trace_pnnx.ncnn.bin", tokens=".sherpa-  
    ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13/tokens.txt", encoder_num_threads=2,  
    decoder_num_threads=2, joiner_num_threads=2)  
DecoderConfig(method="greedy_search", num_active_paths=4, enable_endpoint=False,  
    endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_  
    trailing_silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_  
    nonsilence=True, min_trailing_silence=1.4, min_utterance_length=0),  
    rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_silence=0, min_  
    utterance_length=20)))  
wav filename: ./sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13/test_wavs/1.  
wav  
wav duration (s): 5.1  
Started!  
Done!  
Recognition result for ./sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13/test-  
wavs/1.wav  
ALWAYS ALWAYS  
Elapsed seconds: 0.598 s  
Real time factor (RTF): 0.598 / 5.100 = 0.117  
ModelConfig(encoder_param=".sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13/",  
    encoder_jit_trace_pnnx.ncnn.param", encoder_bin=".sherpa-ncnn-streaming-zipformer-  
    bilingual-zh-en-2023-02-13/encoder_jit_trace_pnnx.ncnn.bin", decoder_param=".sherpa-  
    ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13/decoder_jit_trace_pnnx.ncnn.param",  
    decoder_bin=".sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13/decoder_jit-  
    trace_pnnx.ncnn.bin", joiner_param=".sherpa-ncnn-streaming-zipformer-bilingual-zh-en-  
    2023-02-13/joiner_jit_trace_pnnx.ncnn.param", joiner_bin=".sherpa-ncnn-streaming-  
    zipformer-bilingual-zh-en-2023-02-13/joiner_jit_trace_pnnx.ncnn.bin", tokens=".sherpa-  
    ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13/tokens.txt", encoder_num_threads=2,  
    decoder_num_threads=2, joiner_num_threads=2)  
DecoderConfig(method="modified_beam_search", num_active_paths=4, enable_endpoint=False,  
    endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_  
    trailing_silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_  
    nonsilence=True, min_trailing_silence=1.4, min_utterance_length=0),  
    rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_silence=0, min_  
    utterance_length=20)))  
wav filename: ./sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13/test_wavs/1.  
wav  
wav duration (s): 5.1  
Started!  
Done!
```

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```
Recognition result for ./sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13/test_
↳ wavs/1.wav
ALWAYS ALWAYS
Elapsed seconds: 0.943 s
Real time factor (RTF): 0.943 / 5.100 = 0.185
```

---

**Note:** Please use `./build/bin/Release/sherpa-ncnn.exe` for Windows.

---

**Caution:** If you use Windows and get encoding issues, please run:

```
CHCP 65001
```

in your commandline.

### Real-time speech recognition from a microphone

```
cd /path/to/sherpa-ncnn

./build/bin/sherpa-ncnn-microphone \
  ./sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13/tokens.txt \
  ./sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13/encoder_jit_trace-pnnx.
↳ ncnn.param \
  ./sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13/encoder_jit_trace-pnnx.
↳ ncnn.bin \
  ./sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13/decoder_jit_trace-pnnx.
↳ ncnn.param \
  ./sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13/decoder_jit_trace-pnnx.
↳ ncnn.bin \
  ./sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13/joiner_jit_trace-pnnx.
↳ ncnn.param \
  ./sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13/joiner_jit_trace-pnnx.
↳ ncnn.bin \
  2 \
  greedy_search
```

---

**Hint:** If your system is Linux (including embedded Linux), you can also use `sherpa-ncnn-alsa` to do real-time speech recognition with your microphone if `sherpa-ncnn-microphone` does not work for you.

---

## csukuangfj/sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16 (Bilingual, Chinese + English)

This model is converted from

<https://huggingface.co/csukuangfj/k2fsa-zipformer-bilingual-zh-en-t>

which supports both Chinese and English. The model is contributed by the community and is trained on tens of thousands of some internal dataset.

In the following, we describe how to download it and use it with `sherpa-ncnn`.

---

**Note:** Unlike [csukuangfj/sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13 \(Bilingual, Chinese + English\)](https://huggingface.co/csukuangfj/sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13), this model is much smaller.

---

### Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-ncnn
wget https://github.com/k2-fsa/sherpa-ncnn/releases/download/models/sherpa-ncnn-
˓→streaming-zipformer-small-bilingual-zh-en-2023-02-16.tar.bz2
tar xvf sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16.tar.bz2
```

### Decode a single wave file

---

**Hint:** It supports decoding only wave files with a single channel and the sampling rate should be 16 kHz.

---

```
cd /path/to/sherpa-ncnn

for method in greedy_search modified_beam_search; do
    ./build/bin/sherpa-ncnn \
        ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/tokens.txt \
        ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/encoder_jit_trace-
˓→pnnx.ncnn.param \
        ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/encoder_jit_trace-
˓→pnnx.ncnn.bin \
        ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/decoder_jit_trace-
˓→pnnx.ncnn.param \
        ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/decoder_jit_trace-
˓→pnnx.ncnn.bin \
        ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/joiner_jit_trace-
˓→pnnx.ncnn.param \
        ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/joiner_jit_trace-
˓→pnnx.ncnn.bin \
        ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/test_wavs/1.wav \
    2 \
```

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\$method  
**done**

You should see the following output:

```
ModelConfig(encoder_param=".sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/encoder_jit_trace-pnnx.ncnn.param", encoder_bin=".sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/encoder_jit_trace-pnnx.ncnn.bin", decoder_param=".sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/decoder_jit_trace-pnnx.ncnn.param", decoder_bin=".sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/decoder_jit_trace-pnnx.ncnn.bin", joiner_param=".sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/joiner_jit_trace-pnnx.ncnn.param", joiner_bin=".sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/joiner_jit_trace-pnnx.ncnn.bin", tokens=".sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/tokens.txt", encoder num_threads=2, decoder num_threads=2, joiner num_threads=2)
DecoderConfig(method="greedy_search", num_active_paths=4, enable_endpoint=False, endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_trailing_silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_nonsilence=True, min_trailing_silence=1.4, min_utterance_length=0), rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_silence=0, min_utterance_length=20)))
wav filename: ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/test_wavs/1.wav
wav duration (s): 5.1
Started!
Done!
Recognition result for ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/test_wavs/1.wav
ALWAYS
ModelConfig(encoder_param=".sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/encoder_jit_trace-pnnx.ncnn.param", encoder_bin=".sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/encoder_jit_trace-pnnx.ncnn.bin", decoder_param=".sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/decoder_jit_trace-pnnx.ncnn.param", decoder_bin=".sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/decoder_jit_trace-pnnx.ncnn.bin", joiner_param=".sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/joiner_jit_trace-pnnx.ncnn.param", joiner_bin=".sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/joiner_jit_trace-pnnx.ncnn.bin", tokens=".sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/tokens.txt", encoder num_threads=2, decoder num_threads=2, joiner num_threads=2)
DecoderConfig(method="modified_beam_search", num_active_paths=4, enable_endpoint=False, endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_trailing_silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_nonsilence=True, min_trailing_silence=1.4, min_utterance_length=0), rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_silence=0, min_utterance_length=20)))
wav filename: ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/test_wavs/1.wav
wav duration (s): 5.1
Started!
Done!
```

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```
Recognition result for ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-
˓→16/test_wavs/1.wav
ALWAYS
```

**Note:** Please use `./build/bin/Release/sherpa-ncnn.exe` for Windows.

### Real-time speech recognition from a microphone

```
cd /path/to/sherpa-ncnn

./build/bin/sherpa-ncnn-microphone \
  ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/tokens.txt \
  ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/encoder_jit_trace-
˓→pnnx.ncnn.param \
  ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/encoder_jit_trace-
˓→pnnx.ncnn.bin \
  ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/decoder_jit_trace-
˓→pnnx.ncnn.param \
  ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/decoder_jit_trace-
˓→pnnx.ncnn.bin \
  ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/joiner_jit_trace-
˓→pnnx.ncnn.param \
  ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/joiner_jit_trace-
˓→pnnx.ncnn.bin \
  2 \
  greedy_search
```

**Hint:** If your system is Linux (including embedded Linux), you can also use `sherpa-ncnn-alsa` to do real-time speech recognition with your microphone if `sherpa-ncnn-microphone` does not work for you.

### A faster model of `sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16`

We provide a second version of the model that is exported with `--decode-chunk-len=96` instead of 32.

**Hint:** Please see the model export script at

<https://huggingface.co/csukuangfj/sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/blob/main/96/export-for-ncnn-bilingual-small.sh>

if you are interested.

**Note:** You can also find a third version with folder 64.

The advantage of using this model is that it runs much faster, while the downside is that you will see some delay before you see the recognition result after you speak.

To decode a file, please use:

```
cd /path/to/sherpa-ncnn

for method in greedy_search modified_beam_search; do
    ./build/bin/sherpa-ncnn \
        ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/96/tokens.txt \
        ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/96/encoder_jit_
        ↵trace-pnnx.ncnn.param \
        ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/96/encoder_jit_
        ↵trace-pnnx.ncnn.bin \
        ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/96/decoder_jit_
        ↵trace-pnnx.ncnn.param \
        ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/96/decoder_jit_
        ↵trace-pnnx.ncnn.bin \
        ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/96/joiner_jit_
        ↵trace-pnnx.ncnn.param \
        ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/96/joiner_jit_
        ↵trace-pnnx.ncnn.bin \
        ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/test_wavs/1.wav \
    2 \
    $method
done
```

### shaojieli/sherpa-ncnn-streaming-zipformer-fr-2023-04-14

This model is converted from

<https://huggingface.co/shaojieli/icefall-asr-commonvoice-fr-pruned-transducer-stateless7-streaming-2023-04-02>

which supports only French as it is trained on the [CommonVoice](#) corpus. In the following, we describe how to download it and use it with [sherpa-ncnn](#).

### Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-ncnn

wget https://github.com/k2-fsa/sherpa-ncnn/releases/download/models/sherpa-ncnn-
        ↵streaming-zipformer-fr-2023-04-14.tar.bz2
tar xvf sherpa-ncnn-streaming-zipformer-fr-2023-04-14.tar.bz2
```

To decode a file, please use:

```
cd /path/to/sherpa-ncnn
for method in greedy_search modified_beam_search; do
    ./build/bin/sherpa-ncnn \
        ./sherpa-ncnn-streaming-zipformer-fr-2023-04-14/tokens.txt \
        ./sherpa-ncnn-streaming-zipformer-fr-2023-04-14/encoder_jit_trace-pnnx.ncnn.param \
        ./sherpa-ncnn-streaming-zipformer-fr-2023-04-14/encoder_jit_trace-pnnx.ncnn.bin \
        ./sherpa-ncnn-streaming-zipformer-fr-2023-04-14/decoder_jit_trace-pnnx.ncnn.param \
        ./sherpa-ncnn-streaming-zipformer-fr-2023-04-14/decoder_jit_trace-pnnx.ncnn.bin \

```

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```

./sherpa-ncnn-streaming-zipformer-fr-2023-04-14/joiner_jit_trace-pnnx.ncnn.param \
./sherpa-ncnn-streaming-zipformer-fr-2023-04-14/joiner_jit_trace-pnnx.ncnn.bin \
./sherpa-ncnn-streaming-zipformer-fr-2023-04-14/test_wavs/common_voice_fr_19364697.
wav \
2 \
$method
done

```

You should see the following output:

```

RecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_dim=80),
    model_config=ModelConfig(encoder_param="./sherpa-ncnn-streaming-zipformer-fr-2023-04-
    14/encoder_jit_trace-pnnx.ncnn.param", encoder_bin="./sherpa-ncnn-streaming-zipformer-
    fr-2023-04-14/encoder_jit_trace-pnnx.ncnn.bin", decoder_param="./sherpa-ncnn-streaming-
    zipformer-fr-2023-04-14/decoder_jit_trace-pnnx.ncnn.param", decoder_bin="./sherpa-ncnn-
    streaming-zipformer-fr-2023-04-14/decoder_jit_trace-pnnx.ncnn.bin", joiner_param="./
    sherpa-ncnn-streaming-zipformer-fr-2023-04-14/joiner_jit_trace-pnnx.ncnn.param",
    joiner_bin="./sherpa-ncnn-streaming-zipformer-fr-2023-04-14/joiner_jit_trace-pnnx.ncnn.
    bin", tokens="./sherpa-ncnn-streaming-zipformer-fr-2023-04-14/tokens.txt", encoder_num_
    threads=2, decoder_num_threads=2, joiner_num_threads=2), decoder_
    config=DecoderConfig(method="greedy_search", num_active_paths=4), endpoint_
    config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_trailing_
    silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_nonsilence=True, u
    min_trailing_silence=1.4, min_utterance_length=0), rule3=EndpointRule(must_contain_
    nonsilence=False, min_trailing_silence=0, min_utterance_length=20)), enable_
    endpoint=False)
wav filename: ./sherpa-ncnn-streaming-zipformer-fr-2023-04-14/test_wavs/common_voice_fr_-
19364697.wav
wav duration (s): 7.128
Started!
Done!
Recognition result for ./sherpa-ncnn-streaming-zipformer-fr-2023-04-14/test_wavs/common_
voice_fr_19364697.wav
text: CE SITE CONTIENT QUATRE TOMBEAUX DE LA DYNASTIE ASHÉMÉNIDE ET SEPT DES SASSANDIDES
timestamps: 0.96 1.44 1.52 1.76 1.96 2.08 2.28 2.56 2.64 2.76 2.8 2.96 3.04 3.2 3.28 3.4.
3.48 3.72 3.8 4 4.16 4.24 4.32 4.44 4.6 4.68 4.92 5.2 5.52 5.84 6.04 6.12 6.24 6.56 6.
68
Elapsed seconds: 1.082 s
Real time factor (RTF): 1.082 / 7.128 = 0.152
RecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_dim=80),
    model_config=ModelConfig(encoder_param="./sherpa-ncnn-streaming-zipformer-fr-2023-04-
    14/encoder_jit_trace-pnnx.ncnn.param", encoder_bin="./sherpa-ncnn-streaming-zipformer-
    fr-2023-04-14/encoder_jit_trace-pnnx.ncnn.bin", decoder_param="./sherpa-ncnn-streaming-
    zipformer-fr-2023-04-14/decoder_jit_trace-pnnx.ncnn.param", decoder_bin="./sherpa-ncnn-
    streaming-zipformer-fr-2023-04-14/decoder_jit_trace-pnnx.ncnn.bin", joiner_param="./
    sherpa-ncnn-streaming-zipformer-fr-2023-04-14/joiner_jit_trace-pnnx.ncnn.param",
    joiner_bin="./sherpa-ncnn-streaming-zipformer-fr-2023-04-14/joiner_jit_trace-pnnx.ncnn.
    bin", tokens="./sherpa-ncnn-streaming-zipformer-fr-2023-04-14/tokens.txt", encoder_num_
    threads=2, decoder_num_threads=2, joiner_num_threads=2), decoder_
    config=DecoderConfig(method="modified_beam_search", num_active_paths=4), endpoint_
    config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_trailing_
    silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_nonsilence=True, u
    min_trailing_silence=1.4, min_utterance_length=0), rule3=EndpointRule(must_contain_
    nonsilence=False, min_trailing_silence=0, min_utterance_length=20)), enable_
    endpoint=False)

```

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```
wav filename: ./sherpa-ncnn-streaming-zipformer-fr-2023-04-14/test_wavs/common_voice_fr_
↪19364697.wav
wav duration (s): 7.128
Started!
Done!
Recognition result for ./sherpa-ncnn-streaming-zipformer-fr-2023-04-14/test_wavs/common_
↪voice_fr_19364697.wav
text: CE SITE CONTIENT QUATRE TOMEAUX DE LA DYNASTIE ASHÉMÉNIDE ET SEPT DES SASSANDIDES
timestamps: 0.96 1.44 1.52 1.76 1.96 2.08 2.28 2.56 2.64 2.76 2.8 2.96 3.04 3.2 3.28 3.4_
↪3.48 3.72 3.8 4 4.16 4.24 4.32 4.44 4.6 4.68 4.92 5.2 5.52 5.84 6.04 6.12 6.24 6.56 6.
↪68
Elapsed seconds: 0.812 s
Real time factor (RTF): 0.812 / 7.128 = 0.114
```

---

**Note:** Please use `./build/bin/Release/sherpa-ncnn.exe` for Windows.

---

### Real-time speech recognition from a microphone

```
cd /path/to/sherpa-ncnn
./build/bin/sherpa-ncnn-microphone \
  ./sherpa-ncnn-streaming-zipformer-fr-2023-04-14/tokens.txt \
  ./sherpa-ncnn-streaming-zipformer-fr-2023-04-14/encoder_jit_trace-pnnx.ncnn.param \
  ./sherpa-ncnn-streaming-zipformer-fr-2023-04-14/encoder_jit_trace-pnnx.ncnn.bin \
  ./sherpa-ncnn-streaming-zipformer-fr-2023-04-14/decoder_jit_trace-pnnx.ncnn.param \
  ./sherpa-ncnn-streaming-zipformer-fr-2023-04-14/decoder_jit_trace-pnnx.ncnn.bin \
  ./sherpa-ncnn-streaming-zipformer-fr-2023-04-14/joiner_jit_trace-pnnx.ncnn.param \
  ./sherpa-ncnn-streaming-zipformer-fr-2023-04-14/joiner_jit_trace-pnnx.ncnn.bin \
  ./sherpa-ncnn-streaming-zipformer-fr-2023-04-14/test_wavs/common_voice_fr_19364697.wav_
↪ \
  2 \
  greedy_search
```

---

**Hint:** If your system is Linux (including embedded Linux), you can also use `sherpa-ncnn-alsa` to do real-time speech recognition with your microphone if `sherpa-ncnn-microphone` does not work for you.

---

### 7.9.3 LSTM-transducer-based Models

---

**Hint:** Please refer to [Installation](#) to install `sherpa-ncnn` before you read this section.

---

## marcoyang/sherpa-ncnn-lstm-transducer-small-2023-02-13 (Bilingual, Chinese + English)

This model is a small version of `lstm-transducer` trained in `icefall`.

It only has 13.3 million parameters and can be deployed on embedded devices for real-time speech recognition. You can find the models in `fp16` format at <https://huggingface.co/marcoyang/sherpa-ncnn-lstm-transducer-small-2023-02-13>.

The model is trained on a bi-lingual dataset `tal_csasr` (Chinese + English), so it can be used for both Chinese and English.

In the following, we show you how to download it and deploy it with `sherpa-ncnn`.

Please use the following commands to download it.

```
cd /path/to/sherpa-ncnn
wget https://github.com/k2-fsa/sherpa-ncnn/releases/download/models/sherpa-ncnn-lstm-
      -transducer-small-2023-02-13.tar.bz2
tar xvf sherpa-ncnn-lstm-transducer-small-2023-02-13.tar.bz2
```

**Note:** Please refer to *Embedded Linux (arm)* for how to compile `sherpa-ncnn` for a 32-bit ARM platform.

### Decode a single wave file with `./build/bin/sherpa-ncnn`

**Hint:** It supports decoding only wave files with a single channel and the sampling rate should be 16 kHz.

```
cd /path/to/sherpa-ncnn
./build/bin/sherpa-ncnn \
  ./sherpa-ncnn-lstm-transducer-small-2023-02-13/tokens.txt \
  ./sherpa-ncnn-lstm-transducer-small-2023-02-13/encoder_jit_trace-pnnx.ncnn.param \
  ./sherpa-ncnn-lstm-transducer-small-2023-02-13/encoder_jit_trace-pnnx.ncnn.bin \
  ./sherpa-ncnn-lstm-transducer-small-2023-02-13/decoder_jit_trace-pnnx.ncnn.param \
  ./sherpa-ncnn-lstm-transducer-small-2023-02-13/decoder_jit_trace-pnnx.ncnn.bin \
  ./sherpa-ncnn-lstm-transducer-small-2023-02-13/joiner_jit_trace-pnnx.ncnn.param \
  ./sherpa-ncnn-lstm-transducer-small-2023-02-13/joiner_jit_trace-pnnx.ncnn.bin \
  ./sherpa-ncnn-lstm-transducer-small-2023-02-13/test_wavs/0.wav
```

**Note:** The default option uses 4 threads and `greedy_search` for decoding.

**Note:** Please use `./build/bin/Release/sherpa-ncnn.exe` for Windows.

**Caution:** If you use Windows and get encoding issues, please run:

```
CHCP 65001
```

in your commandline.

### csukuangfi/sherpa-ncnn-2022-09-05 (English)

This is a model trained using the GigaSpeech and the LibriSpeech dataset.

Please see <https://github.com/k2-fsa/icefall/pull/558> for how the model is trained.

You can find the training code at

[https://github.com/k2-fsa/icefall/tree/master/egs/librispeech/ASR/lstm\\_transducer\\_stateless2](https://github.com/k2-fsa/icefall/tree/master/egs/librispeech/ASR/lstm_transducer_stateless2)

In the following, we describe how to download it and use it with `sherpa-ncnn`.

Please use the following commands to download it.

```
cd /path/to/sherpa-ncnn

wget https://github.com/k2-fsa/sherpa-ncnn/releases/download/models/sherpa-ncnn-2022-09-
↪05.tar.bz2
tar xvf sherpa-ncnn-2022-09-05.tar.bz2
```

---

**Hint:** It supports decoding only wave files with a single channel and the sampling rate should be 16 kHz.

---

```
cd /path/to/sherpa-ncnn

for method in greedy_search modified_beam_search; do
  ./build/bin/sherpa-ncnn \
  ./sherpa-ncnn-2022-09-05/tokens.txt \
  ./sherpa-ncnn-2022-09-05/encoder_jit_trace-pnnx.ncnn.param \
  ./sherpa-ncnn-2022-09-05/encoder_jit_trace-pnnx.ncnn.bin \
  ./sherpa-ncnn-2022-09-05/decoder_jit_trace-pnnx.ncnn.param \
  ./sherpa-ncnn-2022-09-05/decoder_jit_trace-pnnx.ncnn.bin \
  ./sherpa-ncnn-2022-09-05/joiner_jit_trace-pnnx.ncnn.param \
  ./sherpa-ncnn-2022-09-05/joiner_jit_trace-pnnx.ncnn.bin \
  ./sherpa-ncnn-2022-09-05/test_wavs/1089-134686-0001.wav \
  2 \
  $method
done
```

You should see the following output:

```
ModelConfig(encoder_param=".sherpa-ncnn-2022-09-05/encoder_jit_trace-pnnx.ncnn.param",
↪encoder_bin=".sherpa-ncnn-2022-09-05/encoder_jit_trace-pnnx.ncnn.bin", decoder_param=
↪".sherpa-ncnn-2022-09-05/decoder_jit_trace-pnnx.ncnn.param", decoder_bin=".sherpa-
↪ncnn-2022-09-05/decoder_jit_trace-pnnx.ncnn.bin", joiner_param=".sherpa-ncnn-2022-09-
↪05/joiner_jit_trace-pnnx.ncnn.param", joiner_bin=".sherpa-ncnn-2022-09-05/joiner_jit_
↪trace-pnnx.ncnn.bin", tokens=".sherpa-ncnn-2022-09-05/tokens.txt", encoder_num_
↪threads=2, decoder_num_threads=2, joiner_num_threads=2)
DecoderConfig(method="greedy_search", num_active_paths=4, enable_endpoint=False,
↪endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_
↪trailing_silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_
↪nonsilence=True, min_trailing_silence=1.4, min_utterance_length=0),
↪rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_silence=0, min_
↪utterance_length=20))) (continues on next page)
```

(continued from previous page)

```

wav filename: ./sherpa-ncnn-2022-09-05/test_wavs/1089-134686-0001.wav
wav duration (s): 6.625
Started!
Done!
Recognition result for ./sherpa-ncnn-2022-09-05/test_wavs/1089-134686-0001.wav
  AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID_
  ↵ QUARTER OF THE BROTHELS
ModelConfig(encoder_param=".sherpa-ncnn-2022-09-05/encoder_jit_trace-pnnx.ncnn.param",_
  ↵ encoder_bin=".sherpa-ncnn-2022-09-05/encoder_jit_trace-pnnx.ncnn.bin", decoder_param=_
  ↵ ".sherpa-ncnn-2022-09-05/decoder_jit_trace-pnnx.ncnn.param", decoder_bin=".sherpa-_
  ↵ -ncnn-2022-09-05/decoder_jit_trace-pnnx.ncnn.bin", joiner_param=".sherpa-ncnn-2022-09-_
  ↵ 05/joiner_jit_trace-pnnx.ncnn.param", joiner_bin=".sherpa-ncnn-2022-09-05/joiner_jit_
  ↵ -trace-pnnx.ncnn.bin", tokens=".sherpa-ncnn-2022-09-05/tokens.txt", encoder_num_
  ↵ -threads=2, decoder_num_threads=2, joiner_num_threads=2)
DecoderConfig(method="modified_beam_search", num_active_paths=4, enable_endpoint=False,_
  ↵ endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_
  ↵ -trailing_silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_
  ↵ -nonsilence=True, min_trailing_silence=1.4, min_utterance_length=0),_
  ↵ rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_silence=0, min_
  ↵ -utterance_length=20)))
wav filename: ./sherpa-ncnn-2022-09-05/test_wavs/1089-134686-0001.wav
wav duration (s): 6.625
Started!
Done!
Recognition result for ./sherpa-ncnn-2022-09-05/test_wavs/1089-134686-0001.wav
  AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID_
  ↵ QUARTER OF THE BROTHELS

```

---

**Note:** Please use `./build/bin/Release/sherpa-ncnn.exe` for Windows.

---

```

cd /path/to/sherpa-ncnn

./build/bin/sherpa-ncnn-microphone \
  ./sherpa-ncnn-2022-09-05/tokens.txt \
  ./sherpa-ncnn-2022-09-05/encoder_jit_trace-pnnx.ncnn.param \
  ./sherpa-ncnn-2022-09-05/encoder_jit_trace-pnnx.ncnn.bin \
  ./sherpa-ncnn-2022-09-05/decoder_jit_trace-pnnx.ncnn.param \
  ./sherpa-ncnn-2022-09-05/decoder_jit_trace-pnnx.ncnn.bin \
  ./sherpa-ncnn-2022-09-05/joiner_jit_trace-pnnx.ncnn.param \
  ./sherpa-ncnn-2022-09-05/joiner_jit_trace-pnnx.ncnn.bin \
  2 \
  greedy_search

```

---

**Note:** Please use `./build/bin/Release/sherpa-ncnn-microphone.exe` for Windows.

---

It will print something like below:

```

Number of threads: 4
num devices: 4

```

(continues on next page)

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```
Use default device: 2
  Name: MacBook Pro Microphone
  Max input channels: 1
Started
```

Speak and it will show you the recognition result in real-time.

You can find a demo below:

```
https://youtu.be/m6ynSxycpX0
```

### csukuangfj/sherpa-ncnn-2022-09-30 (Chinese)

This is a model trained using the [WenetSpeech](#) dataset.

Please see <https://github.com/k2-fsa/icefall/pull/595> for how the model is trained.

In the following, we describe how to download it and use it with [sherpa-ncnn](#).

Please use the following commands to download it.

```
cd /path/to/sherpa-ncnn

wget https://github.com/k2-fsa/sherpa-ncnn/releases/download/models/sherpa-ncnn-2022-09-
˓→30.tar.bz2
tar xvf sherpa-ncnn-2022-09-30.tar.bz2
```

**Hint:** It supports decoding only wave files with a single channel and the sampling rate should be 16 kHz.

```
cd /path/to/sherpa-ncnn

for method in greedy_search modified_beam_search; do
./build/bin/sherpa-ncnn \
  ./sherpa-ncnn-2022-09-30/tokens.txt \
  ./sherpa-ncnn-2022-09-30/encoder_jit_trace-pnnx.ncnn.param \
  ./sherpa-ncnn-2022-09-30/encoder_jit_trace-pnnx.ncnn.bin \
  ./sherpa-ncnn-2022-09-30/decoder_jit_trace-pnnx.ncnn.param \
  ./sherpa-ncnn-2022-09-30/decoder_jit_trace-pnnx.ncnn.bin \
  ./sherpa-ncnn-2022-09-30/joiner_jit_trace-pnnx.ncnn.param \
  ./sherpa-ncnn-2022-09-30/joiner_jit_trace-pnnx.ncnn.bin \
  ./sherpa-ncnn-2022-09-30/test_wavs/0.wav \
  2 \
  $method
done
```

You should see the following output:

```
ModelConfig(encoder_param=".sherpa-ncnn-2022-09-30/encoder_jit_trace-pnnx.ncnn.param",
˓→encoder_bin=".sherpa-ncnn-2022-09-30/encoder_jit_trace-pnnx.ncnn.bin", decoder_param=
˓→".sherpa-ncnn-2022-09-30/decoder_jit_trace-pnnx.ncnn.param", decoder_bin=".sherpa-
˓→ncnn-2022-09-30/decoder_jit_trace-pnnx.ncnn.bin", joiner_param=".sherpa-ncnn-2022-09-
˓→30/joiner_jit_trace-pnnx.ncnn.param", joiner_bin=".sherpa-ncnn-2022-09-30/joiner_jit-
˓→trace-pnnx.ncnn.bin", tokens=".sherpa-ncnn-2022-09-30/tokens.txt", encoder_num_
˓→threads=2, decoder_num_threads=2, joiner_num_threads=2)
```

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(continued from previous page)

```

DecoderConfig(method="greedy_search", num_active_paths=4, enable_endpoint=False, ↴
    ↴ endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_ ↴
    ↴ trailing_silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_ ↴
    ↴ nonsilence=True, min_trailing_silence=1.4, min_utterance_length=0), ↴
    ↴ rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_silence=0, min_ ↴
    ↴ utterance_length=20)))
wav filename: ./sherpa-ncnn-2022-09-30/test_wavs/0.wav
wav duration (s): 5.61462
Started!
Done!
Recognition result for ./sherpa-ncnn-2022-09-30/test_wavs/0.wav

ModelConfig(encoder_param="../sherpa-ncnn-2022-09-30/encoder_jit_trace-pnnx.ncnn.param", ↴
    ↴ encoder_bin="../sherpa-ncnn-2022-09-30/encoder_jit_trace-pnnx.ncnn.bin", decoder_param= ↴
    ↴ "../sherpa-ncnn-2022-09-30/decoder_jit_trace-pnnx.ncnn.param", decoder_bin="../sherpa- ↴
    ↴ -ncnn-2022-09-30/decoder_jit_trace-pnnx.ncnn.bin", joiner_param="../sherpa-ncnn-2022-09- ↴
    ↴ 30/joiner_jit_trace-pnnx.ncnn.param", joiner_bin="../sherpa-ncnn-2022-09-30/joiner_jit_ ↴
    ↴ trace-pnnx.ncnn.bin", tokens="../sherpa-ncnn-2022-09-30/tokens.txt", encoder num_ ↴
    ↴ threads=2, decoder num_threads=2, joiner num_threads=2)
DecoderConfig(method="modified_beam_search", num_active_paths=4, enable_endpoint=False, ↴
    ↴ endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_ ↴
    ↴ trailing_silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_ ↴
    ↴ nonsilence=True, min_trailing_silence=1.4, min_utterance_length=0), ↴
    ↴ rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_silence=0, min_ ↴
    ↴ utterance_length=20)))
wav filename: ./sherpa-ncnn-2022-09-30/test_wavs/0.wav
wav duration (s): 5.61462
Started!
Done!
Recognition result for ./sherpa-ncnn-2022-09-30/test_wavs/0.wav

```

**Caution:** If you use Windows and get encoding issues, please run:

CHCP 65001

in your commandline.

```

cd /path/to/sherpa-ncnn

./build/bin/sherpa-ncnn-microphone \
    ./sherpa-ncnn-2022-09-30/tokens.txt \
    ./sherpa-ncnn-2022-09-30/encoder_jit_trace-pnnx.ncnn.param \
    ./sherpa-ncnn-2022-09-30/encoder_jit_trace-pnnx.ncnn.bin \
    ./sherpa-ncnn-2022-09-30/decoder_jit_trace-pnnx.ncnn.param \
    ./sherpa-ncnn-2022-09-30/decoder_jit_trace-pnnx.ncnn.bin \
    ./sherpa-ncnn-2022-09-30/joiner_jit_trace-pnnx.ncnn.param \
    ./sherpa-ncnn-2022-09-30/joiner_jit_trace-pnnx.ncnn.bin \
    2 \
    greedy_search

```

---

**Note:** Please use `./build/bin/Release/sherpa-ncnn-microphone.exe` for Windows.

---

**Caution:** If you use Windows and get encoding issues, please run:

```
CHCP 65001
```

in your commandline.

You can find a demo below:

```
https://youtu.be/bbQfoRT75oM
```

#### 7.9.4 Conv-Emformer-transducer-based Models

---

**Hint:** Please refer to [Installation](#) to install `sherpa-ncnn` before you read this section.

---

##### **marcoyang/sherpa-ncnn-conv-emformer-transducer-small-2023-01-09 (English)**

This model is a small version of `conv-emformer-transducer` trained in `icefall`.

It only has 8.8 million parameters and can be deployed on embedded devices for real-time speech recognition. You can find the models in `fp16` and `int8` format at <https://huggingface.co/marcoyang/sherpa-ncnn-conv-emformer-transducer-small-2023-01-09>.

This model is trained using `LibriSpeech` and thus it supports only English.

In the following, we show you how to download it and deploy it with `sherpa-ncnn` on an embedded device, whose CPU is `RV1126` (Quad core ARM Cortex-A7)

Please use the following commands to download it.

```
cd /path/to/sherpa-ncnn
wget https://github.com/k2-fsa/sherpa-ncnn/releases/download/models/sherpa-ncnn-conv-
      ↪emformer-transducer-small-2023-01-09.tar.bz2
tar xvf sherpa-ncnn-conv-emformer-transducer-small-2023-01-09.tar.bz2
```

---

**Note:** Please refer to [Embedded Linux \(arm\)](#) for how to compile `sherpa-ncnn` for a 32-bit ARM platform. In the following, we test the pre-trained model on an embedded device, whose CPU is `RV1126` (Quad core ARM Cortex-A7).

---

## Decode a single wave file with ./build/bin/sherpa-ncnn

**Hint:** It supports decoding only wave files with a single channel and the sampling rate should be 16 kHz.

```
cd /path/to/sherpa-ncnn

./build/bin/sherpa-ncnn \
  ./sherpa-ncnn-conv-emformer-transducer-small-2023-01-09/tokens.txt \
  ./sherpa-ncnn-conv-emformer-transducer-small-2023-01-09/encoder_jit_trace-pnnx.ncnn.
  ↵param \
  ↵  ./sherpa-ncnn-conv-emformer-transducer-small-2023-01-09/encoder_jit_trace-pnnx.ncnn.
  ↵bin \
  ↵  ./sherpa-ncnn-conv-emformer-transducer-small-2023-01-09/decoder_jit_trace-pnnx.ncnn.
  ↵param \
  ↵  ./sherpa-ncnn-conv-emformer-transducer-small-2023-01-09/decoder_jit_trace-pnnx.ncnn.
  ↵bin \
  ↵  ./sherpa-ncnn-conv-emformer-transducer-small-2023-01-09/joiner_jit_trace-pnnx.ncnn.
  ↵param \
  ↵  ./sherpa-ncnn-conv-emformer-transducer-small-2023-01-09/joiner_jit_trace-pnnx.ncnn.bin
  ↵ \
  ↵  ./sherpa-ncnn-conv-emformer-transducer-small-2023-01-09/test_wavs/1089-134686-0001.wav
  ↵\
```

The outputs are shown below. The CPU used for decoding is RV1126 (Quad core ARM Cortex-A7).

```
[root@RV1126_RV1109:/asr/small]# time ./sherpa-ncnn tokens.txt encoder_jit_trace
-pnnx.ncnn.param encoder_jit_trace-pnnx.ncnn.bin decoder_jit_trace-pnnx.ncnn.par
am decoder_jit_trace-pnnx.ncnn.bin joiner_jit_trace-pnnx.ncnn.param joiner_jit_t
race-pnnx.ncnn.bin ./test_wavs/1089-134686-0001.wav 4 greedy_search
Don't Use GPU. has_gpu: 0, config.use_vulkan_compute: 1
ModelConfig(encoder_param="encoder_jit_trace-pnnx.ncnn.param", encoder_bin="encoder_jit_trace-pnnx.ncnn.bin", decoder_param="decoder_jit_trace-pnnx.ncnn.param", decoder_bin="decoder_jit_trace-pnnx.ncnn.bin", joiner_param="joiner_jit_trace-pnnx.ncnn.param", joiner_bin="joiner_jit_trace-pnnx.ncnn.bin", tokens="tokens.txt", encoder_num_threads=4, decoder_num_threads=4, joiner_num_threads=4)
wav filename: ./test_wavs/1089-134686-0001.wav
wav duration (s): 6.625
Recognition result for ./test_wavs/1089-134686-0001.wav
  AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID QUARTER OF THE BRAFFLES
real    0m 3.26s
user    0m 10.75s
sys     0m 0.23s
```

**Note:** The default option uses 4 threads and greedy\_search for decoding.

**Note:** Please use ./build/bin/Release/sherpa-ncnn.exe for Windows.

**Caution:** If you use Windows and get encoding issues, please run:

CHCP 65001

in your commandline.

**Decode a single wave file with ./build/bin/sherpa-ncnn (with int8 quantization)**

---

**Note:** We also support int8 quantization to compresss the model and speed up inference. Currently, only encoder and joiner are quantized.

---

To decode the int8-quantized model, use the following command:

```
cd /path/to/sherpa-ncnn

./build/bin/sherpa-ncnn \
  ./sherpa-ncnn-conv-emformer-transducer-small-2023-01-09/tokens.txt \
  ./sherpa-ncnn-conv-emformer-transducer-small-2023-01-09/encoder_jit_trace-pnnx.ncnn.
  ↵int8.param \
  ./sherpa-ncnn-conv-emformer-transducer-small-2023-01-09/encoder_jit_trace-pnnx.ncnn.
  ↵int8.bin \
  ./sherpa-ncnn-conv-emformer-transducer-small-2023-01-09/decoder_jit_trace-pnnx.ncnn.
  ↵param \
  ./sherpa-ncnn-conv-emformer-transducer-small-2023-01-09/decoder_jit_trace-pnnx.ncnn.
  ↵bin \
  ./sherpa-ncnn-conv-emformer-transducer-small-2023-01-09/joiner_jit_trace-pnnx.ncnn.
  ↵int8.param \
  ./sherpa-ncnn-conv-emformer-transducer-small-2023-01-09/joiner_jit_trace-pnnx.ncnn.
  ↵int8.bin \
  ./sherpa-ncnn-conv-emformer-transducer-small-2023-01-09/test_wavs/1089-134686-0001.wav
  ↵\
```

The outputs are shown below. The CPU used for decoding is RV1126 (Quad core ARM Cortex-A7).

```
[root@RV1126_RV1109:/asr/small]# time ./sherpa-ncnn tokens.txt encoder_jit_trace
-pnnx.ncnn.int8.param encoder_jit_trace-pnnx.ncnn.int8.bin decoder_jit_trace-pnn
x.ncnn.param decoder_jit_trace-pnnx.ncnn.bin joiner_jit_trace-pnnx.ncnn.int8.par
am joiner_jit_trace-pnnx.ncnn.int8.bin ./test_wavs/1089-134686-0001.wav 4 greedy
_search
Don't Use GPU. has_gpu: 0, config.use_vulkan_compute: 1
ModelConfig(encoder_param="encoder_jit_trace-pnnx.ncnn.int8.param", encoder_bin="encoder_jit_trace-pnnx.ncnn.int8.bin", decoder_param="d
ecoder_jit_trace-pnnx.ncnn.param", decoder_bin="decoder_jit_trace-pnnx.ncnn.bin", joiner_param="joiner_jit_trace-pnnx.ncnn.int8.param",
joiner_bin="joiner_jit_trace-pnnx.ncnn.int8.bin", tokens="tokens.txt", encoder_num_threads=4, decoder_num_threads=4, joiner_num_threads=4)
wav filename: ./test_wavs/1089-134686-0001.wav
wav duration (s): 6.625
Recognition result for ./test_wavs/1089-134686-0001.wav
  AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID QUARTER OF THE BRAFFLES
real    0m 2.44s
user    0m 7.89s
sys     0m 0.23s
```

Compared to the original model in fp16 format, the decoding speed is significantly improved. The decoding time is changed from 3.26 s to 2.44 s.

---

**Note:** When the model's weights are quantized to float16, it is converted to float32 during computation.

When the model's weights are quantized to int8, it is using int8 during computation.

---

**Hint:** Even if we use only 1 thread for the int8 model, the resulting real time factor (RTF) is still less than 1.

---

## csukuangfj/sherpa-ncnn-conv-emformer-transducer-2022-12-06 (Chinese + English)

This model is converted from <https://huggingface.co/ptrnull/icefall-asr-conv-emformer-transducer-stateless2-zh>, which supports both Chinese and English.

**Hint:** If you want to train your own model that is able to support both Chinese and English, please refer to our training code:

[https://github.com/k2-fsa/icefall/tree/master/egs/tal\\_csasr/ASR](https://github.com/k2-fsa/icefall/tree/master/egs/tal_csasr/ASR)

You can also try the pre-trained models in your browser without installing anything by visiting:

<https://huggingface.co/spaces/k2-fsa/automatic-speech-recognition>

In the following, we describe how to download and use it with `sherpa-ncnn`.

Please use the following commands to download it.

```
cd /path/to/sherpa-ncnn
wget https://github.com/k2-fsa/sherpa-ncnn/releases/download/models/sherpa-ncnn-conv-
      ↵emformer-transducer-2022-12-06.tar.bz2
tar xvf sherpa-ncnn-conv-emformer-transducer-2022-12-06.tar.bz2
```

### Decode a single wave file with `./build/bin/sherpa-ncnn`

**Hint:** It supports decoding only wave files with a single channel and the sampling rate should be 16 kHz.

```
cd /path/to/sherpa-ncnn
./build/bin/sherpa-ncnn \
  ./sherpa-ncnn-conv-emformer-transducer-2022-12-06/tokens.txt \
  ./sherpa-ncnn-conv-emformer-transducer-2022-12-06/encoder_jit_trace-pnnx.ncnn.param \
  ./sherpa-ncnn-conv-emformer-transducer-2022-12-06/encoder_jit_trace-pnnx.ncnn.bin \
  ./sherpa-ncnn-conv-emformer-transducer-2022-12-06/decoder_jit_trace-pnnx.ncnn.param \
  ./sherpa-ncnn-conv-emformer-transducer-2022-12-06/decoder_jit_trace-pnnx.ncnn.bin \
  ./sherpa-ncnn-conv-emformer-transducer-2022-12-06/joiner_jit_trace-pnnx.ncnn.param \
  ./sherpa-ncnn-conv-emformer-transducer-2022-12-06/joiner_jit_trace-pnnx.ncnn.bin \
  ./sherpa-ncnn-conv-emformer-transducer-2022-12-06/test_wavs/0.wav \
```

**Note:** Please use `./build/bin/Release/sherpa-ncnn.exe` for Windows.

**Caution:** If you use Windows and get encoding issues, please run:

`CHCP 65001`

in your commandline.

### Real-time speech recognition from a microphone with build/bin/sherpa-ncnn-microphone

```
cd /path/to/sherpa-ncnn
./build/bin/sherpa-ncnn-microphone \
./sherpa-ncnn-conv-emformer-transducer-2022-12-06/tokens.txt \
./sherpa-ncnn-conv-emformer-transducer-2022-12-06/encoder_jit_trace-pnnx.ncnn.param \
./sherpa-ncnn-conv-emformer-transducer-2022-12-06/encoder_jit_trace-pnnx.ncnn.bin \
./sherpa-ncnn-conv-emformer-transducer-2022-12-06/decoder_jit_trace-pnnx.ncnn.param \
./sherpa-ncnn-conv-emformer-transducer-2022-12-06/decoder_jit_trace-pnnx.ncnn.bin \
./sherpa-ncnn-conv-emformer-transducer-2022-12-06/joiner_jit_trace-pnnx.ncnn.param \
./sherpa-ncnn-conv-emformer-transducer-2022-12-06/joiner_jit_trace-pnnx.ncnn.bin
```

---

**Note:** Please use ./build/bin/Release/sherpa-ncnn-microphone.exe for Windows.

---

It will print something like below:

```
Number of threads: 4
num devices: 4
Use default device: 2
  Name: MacBook Pro Microphone
  Max input channels: 1
Started
```

Speak and it will show you the recognition result in real-time.

**Caution:** If you use Windows and get encoding issues, please run:

```
CHCP 65001
```

in your commandline.

### csukuangfj/sherpa-ncnn-conv-emformer-transducer-2022-12-08 (Chinese)

---

**Hint:** This is a very small model that can be run in real-time on embedded systems.

---

This model is trained using [WenetSpeech](#) dataset and it supports only Chinese.

In the following, we describe how to download and use it with [sherpa-ncnn](#).

Please use the following commands to download it.

```
cd /path/to/sherpa-ncnn

wget https://github.com/k2-fsa/sherpa-ncnn/releases/download/models/sherpa-ncnn-conv-
      -emformer-transducer-2022-12-08.tar.bz2
tar xvf sherpa-ncnn-conv-emformer-transducer-2022-12-08.tar.bz2
```

## Decode a single wave file with ./build/bin/sherpa-ncnn

**Hint:** It supports decoding only wave files with a single channel and the sampling rate should be 16 kHz.

```
cd /path/to/sherpa-ncnn

./build/bin/sherpa-ncnn \
./sherpa-ncnn-conv-emformer-transducer-2022-12-08/tokens.txt \
./sherpa-ncnn-conv-emformer-transducer-2022-12-08/encoder_jit_trace-pnnx.ncnn.param \
./sherpa-ncnn-conv-emformer-transducer-2022-12-08/encoder_jit_trace-pnnx.ncnn.bin \
./sherpa-ncnn-conv-emformer-transducer-2022-12-08/decoder_jit_trace-pnnx.ncnn.param \
./sherpa-ncnn-conv-emformer-transducer-2022-12-08/decoder_jit_trace-pnnx.ncnn.bin \
./sherpa-ncnn-conv-emformer-transducer-2022-12-08/joiner_jit_trace-pnnx.ncnn.param \
./sherpa-ncnn-conv-emformer-transducer-2022-12-08/joiner_jit_trace-pnnx.ncnn.bin \
./sherpa-ncnn-conv-emformer-transducer-2022-12-08/test_wavs/0.wav
```

**Note:** Please use ./build/bin/Release/sherpa-ncnn.exe for Windows.

**Caution:** If you use Windows and get encoding issues, please run:

CHCP 65001

in your commandline.

## Real-time speech recognition from a microphone with build/bin/sherpa-ncnn-microphone

```
cd /path/to/sherpa-ncnn
./build/bin/sherpa-ncnn-microphone \
./sherpa-ncnn-conv-emformer-transducer-2022-12-08/tokens.txt \
./sherpa-ncnn-conv-emformer-transducer-2022-12-08/encoder_jit_trace-pnnx.ncnn.param \
./sherpa-ncnn-conv-emformer-transducer-2022-12-08/encoder_jit_trace-pnnx.ncnn.bin \
./sherpa-ncnn-conv-emformer-transducer-2022-12-08/decoder_jit_trace-pnnx.ncnn.param \
./sherpa-ncnn-conv-emformer-transducer-2022-12-08/decoder_jit_trace-pnnx.ncnn.bin \
./sherpa-ncnn-conv-emformer-transducer-2022-12-08/joiner_jit_trace-pnnx.ncnn.param \
./sherpa-ncnn-conv-emformer-transducer-2022-12-08/joiner_jit_trace-pnnx.ncnn.bin
```

**Note:** Please use ./build/bin/Release/sherpa-ncnn-microphone.exe for Windows.

It will print something like below:

```
Number of threads: 4
num devices: 4
Use default device: 2
  Name: MacBook Pro Microphone
  Max input channels: 1
Started
```

Speak and it will show you the recognition result in real-time.

**Caution:** If you use Windows and get encoding issues, please run:

```
CHCP 65001
```

in your commandline.

### csukuangfj/sherpa-ncnn-conv-emformer-transducer-2022-12-04 (English)

This model is trained using [GigaSpeech](#) and [LibriSpeech](#). It supports only English.

In the following, we describe how to download and use it with [sherpa-ncnn](#).

Please use the following commands to download it.

```
cd /path/to/sherpa-ncnn

wget https://github.com/k2-fsa/sherpa-ncnn/releases/download/models/sherpa-ncnn-conv-
      ↵emformer-transducer-2022-12-04.tar.bz2
tar xvf sherpa-ncnn-conv-emformer-transducer-2022-12-04.tar.bz2
```

### Decode a single wave file with ./build/bin/sherpa-ncnn

---

**Hint:** It supports decoding only wave files with a single channel and the sampling rate should be 16 kHz.

---

```
cd /path/to/sherpa-ncnn

./build/bin/sherpa-ncnn \
  ./sherpa-ncnn-conv-emformer-transducer-2022-12-04/tokens.txt \
  ./sherpa-ncnn-conv-emformer-transducer-2022-12-04/encoder_jit_trace-pnnx.ncnn.param \
  ./sherpa-ncnn-conv-emformer-transducer-2022-12-04/encoder_jit_trace-pnnx.ncnn.bin \
  ./sherpa-ncnn-conv-emformer-transducer-2022-12-04/decoder_jit_trace-pnnx.ncnn.param \
  ./sherpa-ncnn-conv-emformer-transducer-2022-12-04/decoder_jit_trace-pnnx.ncnn.bin \
  ./sherpa-ncnn-conv-emformer-transducer-2022-12-04/joiner_jit_trace-pnnx.ncnn.param \
  ./sherpa-ncnn-conv-emformer-transducer-2022-12-04/joiner_jit_trace-pnnx.ncnn.bin \
  ./sherpa-ncnn-conv-emformer-transducer-2022-12-04/test_wavs/1089-134686-0001.wav
```

---

**Note:** Please use ./build/bin/Release/sherpa-ncnn.exe for Windows.

---

**Caution:** If you use Windows and get encoding issues, please run:

```
CHCP 65001
```

in your commandline.

## Real-time speech recognition from a microphone with build/bin/sherpa-ncnn-microphone

```
cd /path/to/sherpa-ncnn
./build/bin/sherpa-ncnn-microphone \
./sherpa-ncnn-conv-emformer-transducer-2022-12-04/tokens.txt \
./sherpa-ncnn-conv-emformer-transducer-2022-12-04/encoder_jit_trace-pnnx.ncnn.param \
./sherpa-ncnn-conv-emformer-transducer-2022-12-04/encoder_jit_trace-pnnx.ncnn.bin \
./sherpa-ncnn-conv-emformer-transducer-2022-12-04/decoder_jit_trace-pnnx.ncnn.param \
./sherpa-ncnn-conv-emformer-transducer-2022-12-04/decoder_jit_trace-pnnx.ncnn.bin \
./sherpa-ncnn-conv-emformer-transducer-2022-12-04/joiner_jit_trace-pnnx.ncnn.bin \
./sherpa-ncnn-conv-emformer-transducer-2022-12-04/joiner_jit_trace-pnnx.ncnn.param
```

**Note:** Please use ./build/bin/Release/sherpa-ncnn-microphone.exe for Windows.

It will print something like below:

```
Number of threads: 4
num devices: 4
Use default device: 2
  Name: MacBook Pro Microphone
  Max input channels: 1
Started
```

Speak and it will show you the recognition result in real-time.

**Caution:** If you use Windows and get encoding issues, please run:

```
CHCP 65001
```

in your commandline.

## 7.10 Examples

In this section, we describe some usage examples of `sherpa-ncnn` on various boards.

### 7.10.1 Raspberry Pi 3B E14

This page posts some screenshots of running `sherpa-ncnn` on Raspberry Pi 3B E14.

**Hint:** You can find pre-compiled binaries used in this example at

```
https://huggingface.co/csukuangfj/sherpa-ncnn-pre-compiled-binaries/tree/main/arm32
```

## Board info

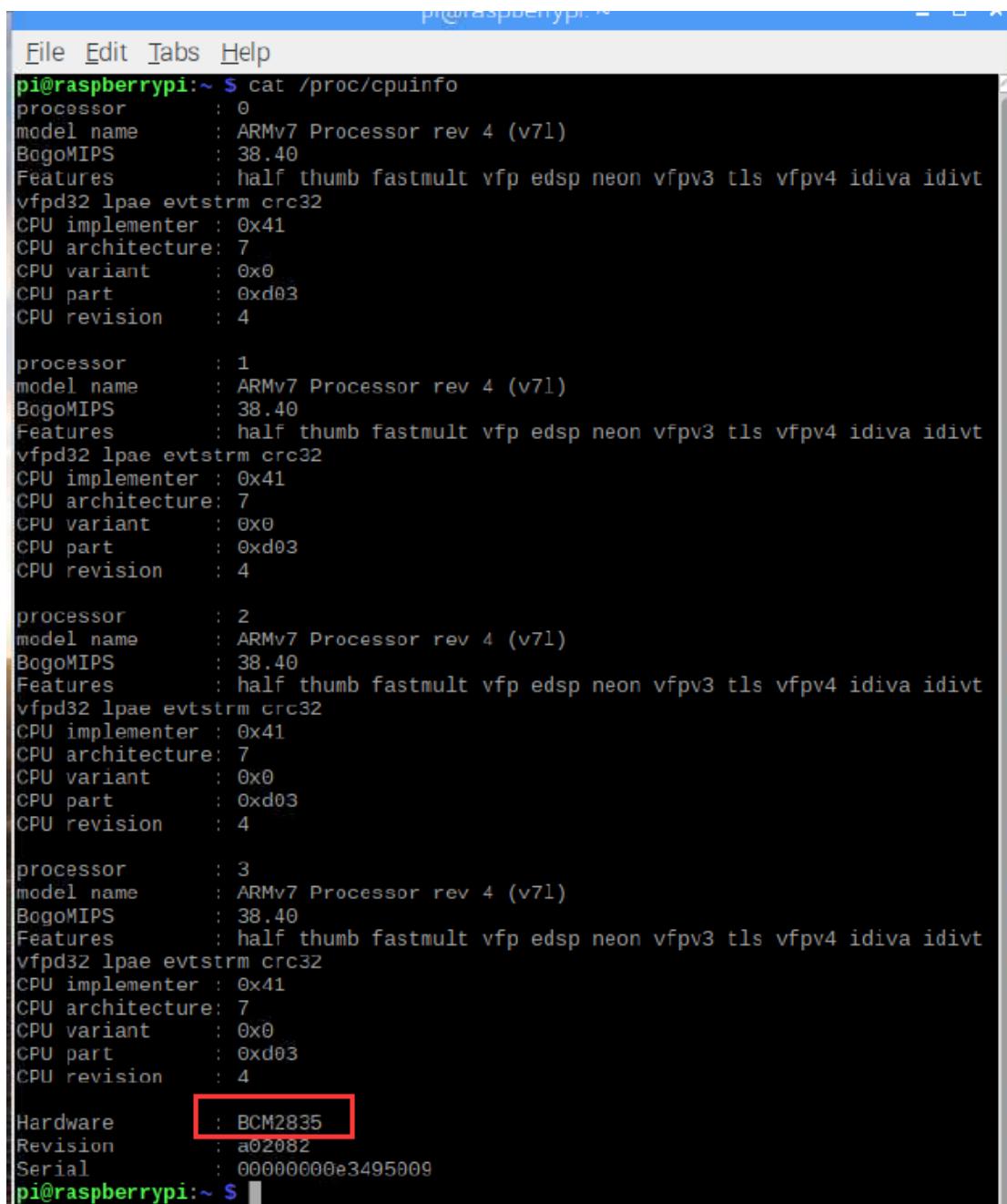
## OS release

```
pi@raspberrypi: ~
File Edit Tabs Help
pi@raspberrypi:~ $ cat /etc/os-release
PRETTY_NAME="Raspbian GNU/Linux 10 (buster)"
NAME="Raspbian GNU/Linux"
VERSION_ID="10"
VERSION="10 (buster)"
VERSION_CODENAME=buster
ID=raspbian
ID_LIKE=debian
HOME_URL="http://www.raspbian.org/"
SUPPORT_URL="http://www.raspbian.org/RaspbianForums"
BUG_REPORT_URL="http://www.raspbian.org/RaspbianBugs"
pi@raspberrypi:~ $
```

**lscpu**

```
pi@raspberrypi:~ $ lscpu
Architecture:          armv7l
Byte Order:            Little Endian
CPU(s):                4
On-line CPU(s) list:  0-3
Thread(s) per core:   1
Core(s) per socket:   4
Socket(s):             1
Vendor ID:             ARM
Model:                 4
Model name:            Cortex-A53
Stepping:               r0p4
CPU max MHz:           1200.0000
CPU min MHz:           600.0000
BogoMIPS:               57.60
Flags:                 half thumb fastmult vfp edsp neon vfpv3 tls vfpv4 idiva idivt vfpd32 lpae evtstrm crc32
```

## cpuinfo



```
pi@raspberrypi:~$ cat /proc/cpuinfo
processor       : 0
model name     : ARMv7 Processor rev 4 (v7l)
BogoMIPS       : 38.40
Features       : half thumb fastmult vfp edsp neon vfpv3 tls vfpv4 idiva idivt
vfpd32 lpae evtstrm crc32
CPU implementer : 0x41
CPU architecture: 7
CPU variant    : 0x0
CPU part       : 0xd03
CPU revision   : 4

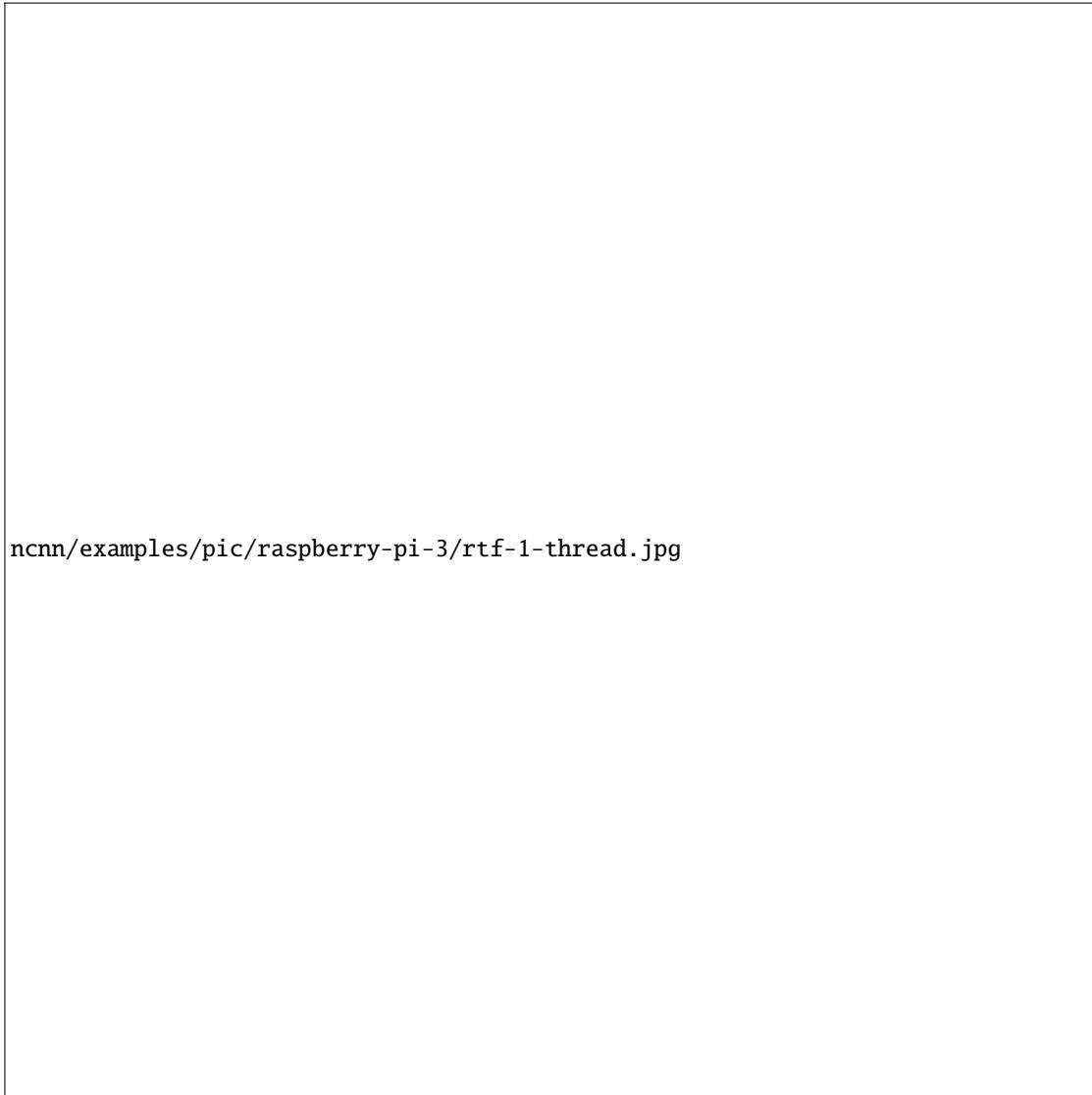
processor       : 1
model name     : ARMv7 Processor rev 4 (v7l)
BogoMIPS       : 38.40
Features       : half thumb fastmult vfp edsp neon vfpv3 tls vfpv4 idiva idivt
vfpd32 lpae evtstrm crc32
CPU implementer : 0x41
CPU architecture: 7
CPU variant    : 0x0
CPU part       : 0xd03
CPU revision   : 4

processor       : 2
model name     : ARMv7 Processor rev 4 (v7l)
BogoMIPS       : 38.40
Features       : half thumb fastmult vfp edsp neon vfpv3 tls vfpv4 idiva idivt
vfpd32 lpae evtstrm crc32
CPU implementer : 0x41
CPU architecture: 7
CPU variant    : 0x0
CPU part       : 0xd03
CPU revision   : 4

processor       : 3
model name     : ARMv7 Processor rev 4 (v7l)
BogoMIPS       : 38.40
Features       : half thumb fastmult vfp edsp neon vfpv3 tls vfpv4 idiva idivt
vfpd32 lpae evtstrm crc32
CPU implementer : 0x41
CPU architecture: 7
CPU variant    : 0x0
CPU part       : 0xd03
CPU revision   : 4

Hardware        : BCM2835
Revision        : a02082
Serial          : 00000000e3495009
pi@raspberrypi:~$
```

**RTF (1 thread)**



**RTF (2 threads)**



ncnn/examples/pic/raspberry-pi-3/rtf-2-threads.jpg

### 7.10.2 Jetson Nano

This page posts some screenshots of running sherpa-ncnn on Jetson Nano.

---

**Hint:** You can find pre-compiled binaries used in this example at

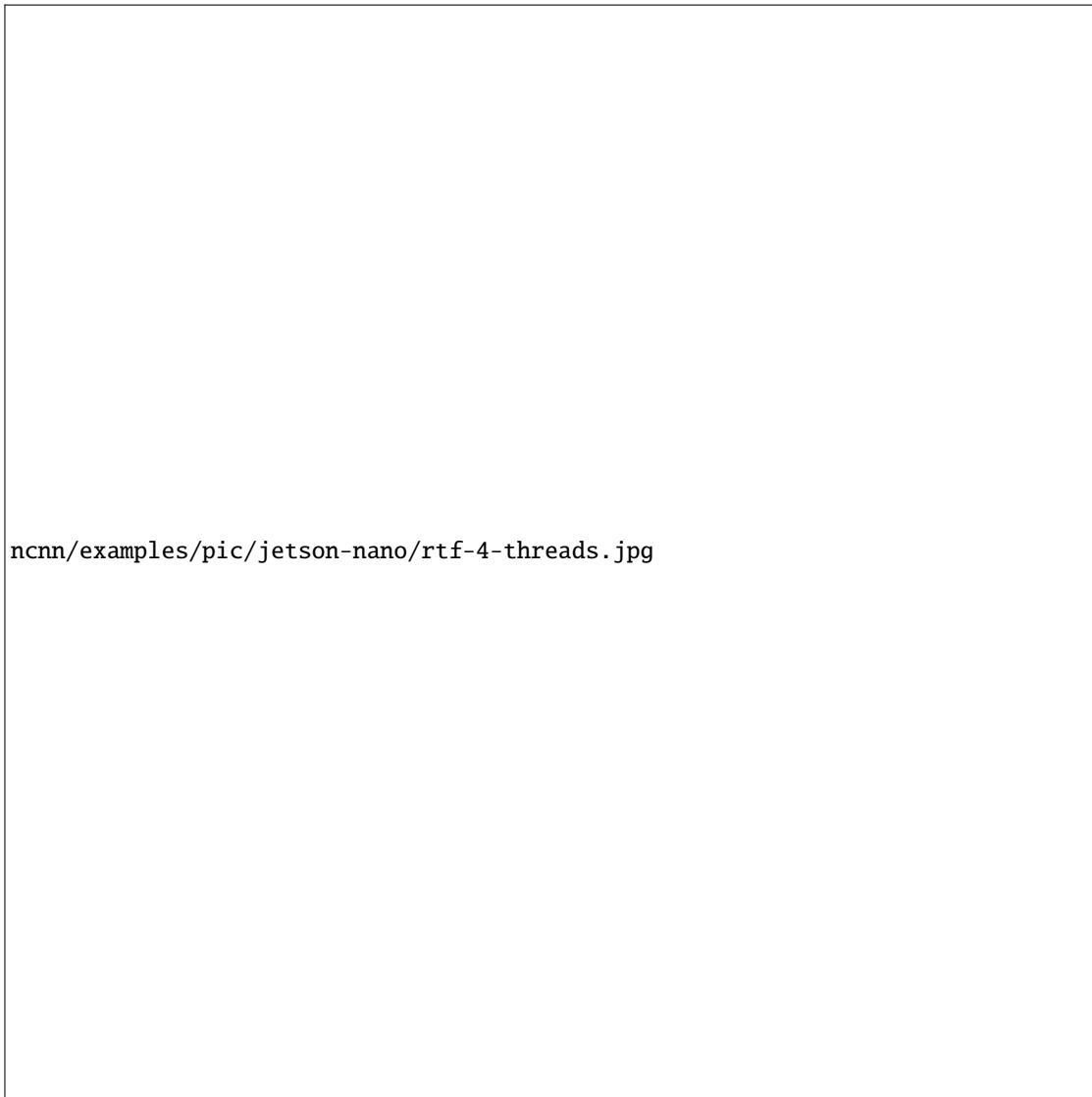
<https://huggingface.co/csukuangfj/sherpa-ncnn-pre-compiled-binaries/tree/main/aarch64>

---

## Board info

```
nikki@nikki-desktop:~/Downloads/sherpa-ncnn/sherpa-ncnn-streaming-zipformer-zh-14M-2023-02-23$ lscpu
Architecture:           aarch64
Byte Order:             Little Endian
CPU(s):                4
On-line CPU(s) list:  0-3
Thread(s) per core:   1
Core(s) per socket:   4
Socket(s):             1
Vendor ID:             ARM
Model:                 1
Model name:            Cortex-A57
Stepping:               r1p1
CPU max MHz:           1479.0000
CPU min MHz:           102.0000
BogoMIPS:              38.40
L1d cache:             32K
L1i cache:             48K
L2 cache:              2048K
Flags:                 fp asimd evtstrm aes pmull sha1 sha2 crc32
nikki@nikki-desktop:~/Downloads/sherpa-ncnn/sherpa-ncnn-streaming-zipformer-zh-14M-2023-02-23$ lsb_release -a
No LSB modules are available.
Distributor ID:        Ubuntu
Description:            Ubuntu 18.04.6 LTS
Release:                18.04
Codename:               bionic
nikki@nikki-desktop:~/Downloads/sherpa-ncnn/sherpa-ncnn-streaming-zipformer-zh-14M-2023-02-23$ uname -a
Linux nikki-desktop 4.9.253-tegra #1 SMP PREEMPT Sat Feb 19 08:59:22 PST 2022 aarch64 aarch64 aarch64 GNU/Linux
nikki@nikki-desktop:~/Downloads/sherpa-ncnn/sherpa-ncnn-streaming-zipformer-zh-14M-2023-02-23$
```

**RTF (4 threads)**



### 7.10.3 Jetson NX

This page posts some screenshots of running `sherpa-ncnn` on **Jetson NX**.

---

**Hint:** You can find pre-compiled binaries used in this example at

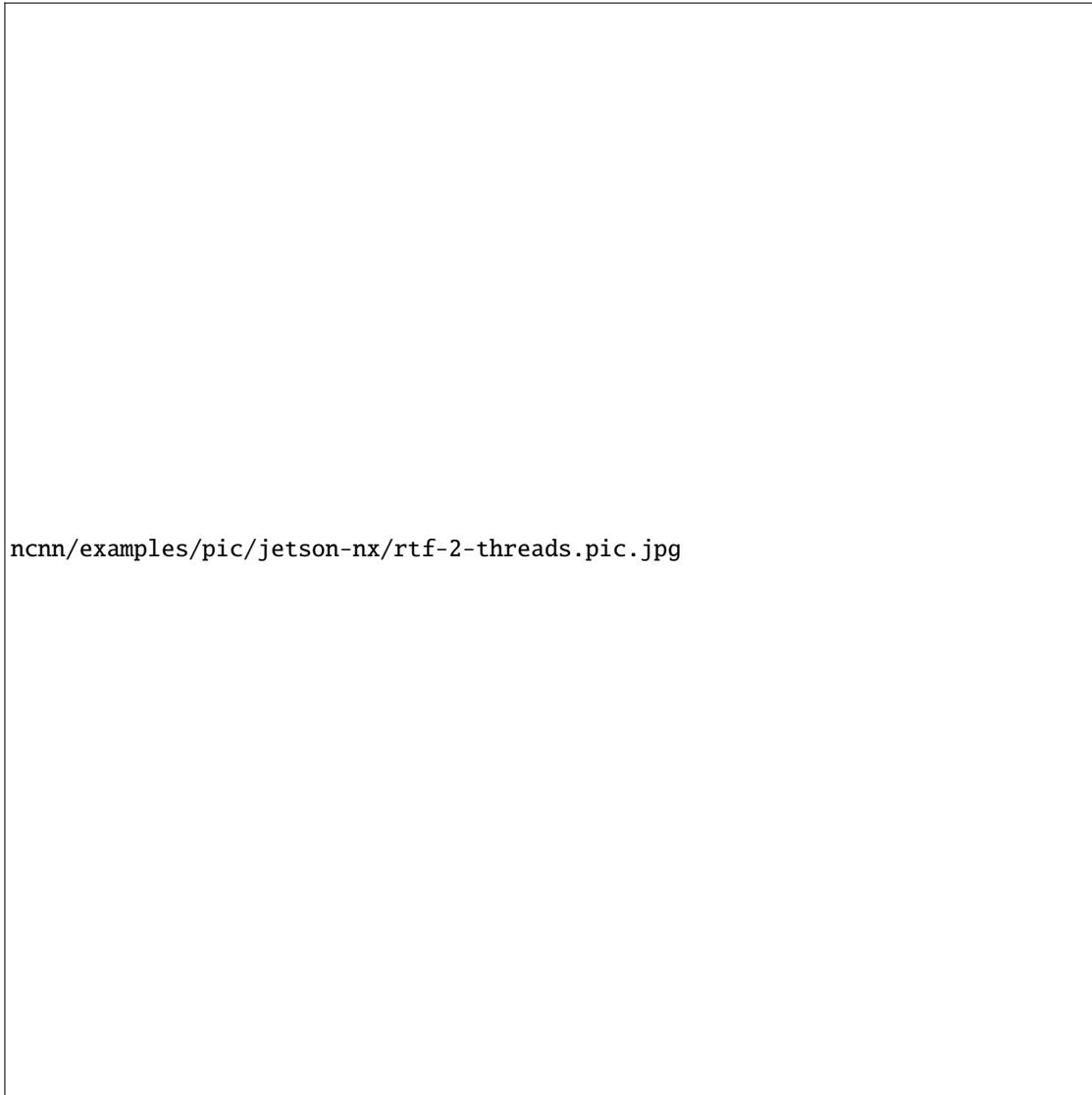
<https://huggingface.co/csukuangfj/sherpa-ncnn-pre-compiled-binaries/tree/main/aarch64>

---

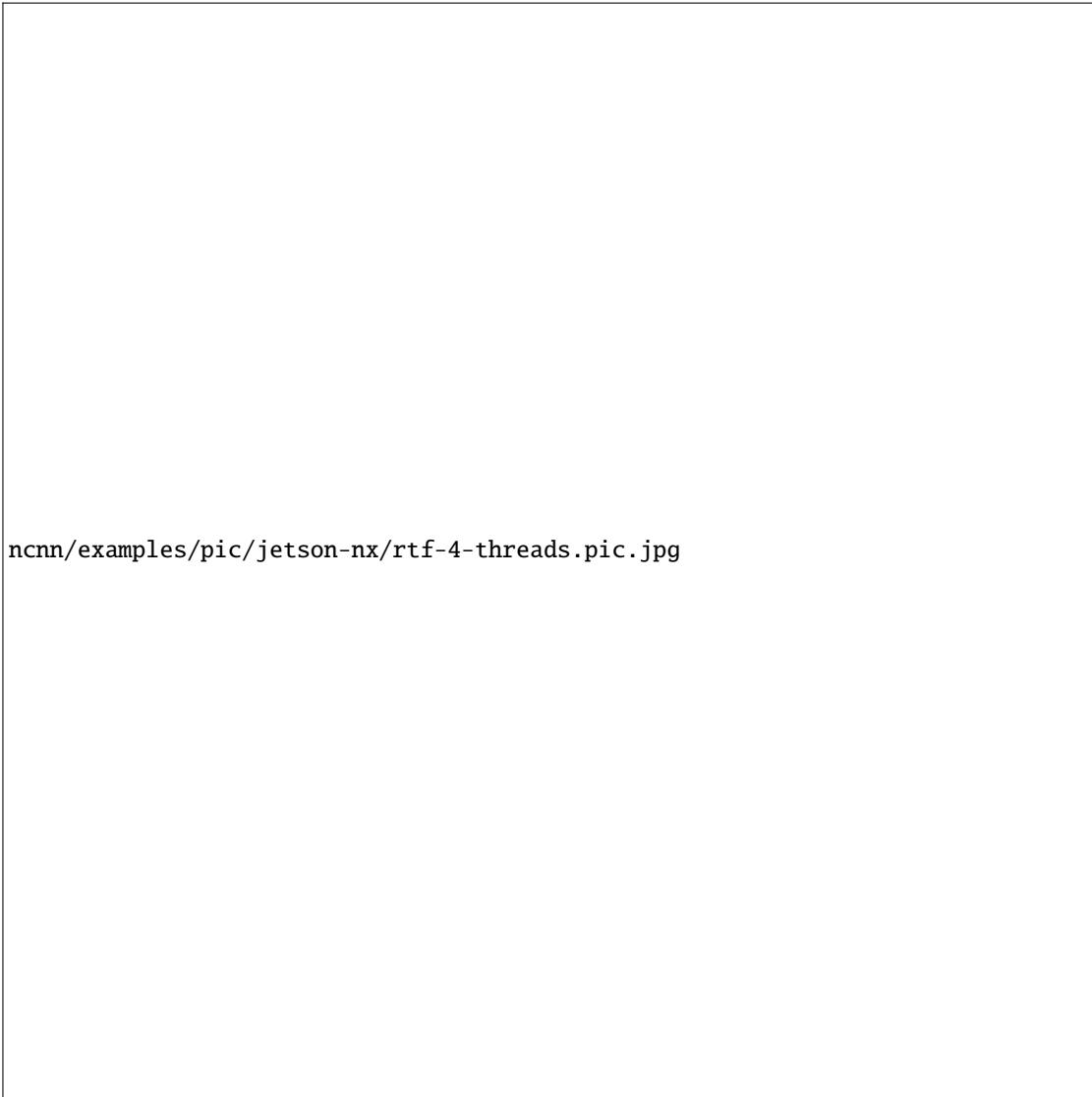
## Board info

```
e2ai@e2ai-desktop:~/Downloads/sherpa-ncnn/sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13$ lscpu
Architecture:           aarch64
Byte Order:             Little Endian
CPU(s):                6
On-line CPU(s) list:  0-5
Thread(s) per core:   1
Core(s) per socket:   2
Socket(s):             3
Vendor ID:             Nvidia
Model:                 0
Model name:            ARMv8 Processor rev 0 (v8l)
Stepping:               0x0
CPU max MHz:           1907.2000
CPU min MHz:           115.2000
BogoMIPS:              62.50
L1d cache:             64K
L1i cache:             128K
L2 cache:              2048K
L3 cache:              4096K
Flags:                 fp asimd evtstrm aes pmull sha1 sha2 crc32 atomics fphp asimdhp
e2ai@e2ai-desktop:~/Downloads/sherpa-ncnn/sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13$ lsb_release -a
No LSB modules are available.
Distributor ID:        Ubuntu
Description:            Ubuntu 18.04.6 LTS
Release:                18.04
Codename:               bionic
e2ai@e2ai-desktop:~/Downloads/sherpa-ncnn/sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13$ uname -a
Linux e2ai-desktop 4.9.253-tegra #1 SMP PREEMPT Sat Feb 19 08:58:27 PST 2022 aarch64 aarch64 aarch64 GNU/Linux
e2ai@e2ai-desktop:~/Downloads/sherpa-ncnn/sherpa-ncnn-streaming-zipformer-bilingual-zh-en-2023-02-13$ █
```

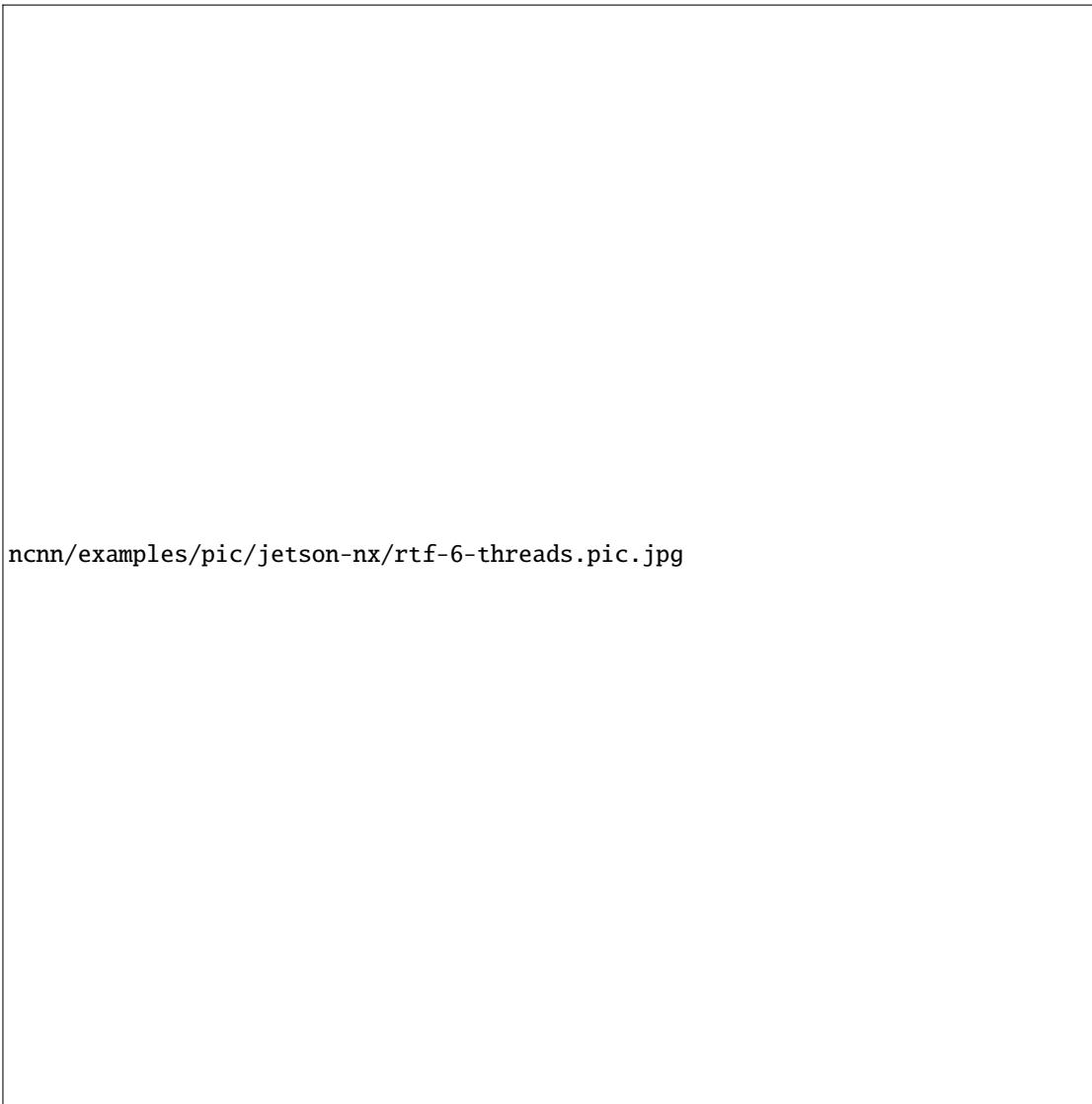
**RTF (2 threads)**



#### RTF (4 threads)



### RTF (6 threads)



#### 7.10.4 VisionFive 2

This page describes how to run `sherpa-ncnn` on `VisionFive2`, which is a 64-bit RISC-V board with 4 CPUs.

---

**Hint:** You can find pre-compiled binaries used in this example at

<https://huggingface.co/csukuangfj/sherpa-ncnn-pre-compiled-binaries/tree/main/riscv64>

---

**Caution:** The latest debian image from [https://doc-en.rvospace.org/VisionFive2/Quick\\_Start\\_Guide/VisionFive2\\_QSG/flashing\\_with\\_mac\\_linux.html](https://doc-en.rvospace.org/VisionFive2/Quick_Start_Guide/VisionFive2_QSG/flashing_with_mac_linux.html) does not work since it does not support USB devices.

That is, you cannot use USB microphones on the board with the above debian image.

---

**Note:** We have compiled <https://github.com/starfive-tech/VisionFive2> and the resulting `sdcard.img` is available at <https://huggingface.co/csukuangfj/visionfive2-sd-card-img>.

Please use this image for testing. It supports USB microphones.

The username for this image is `root` and the password is `starfive`.

---

## Board info

```
on the cross build: ~
root@buildroot:~# lscpu
Architecture:          riscv64
Byte Order:            Little Endian
CPU(s):                4
On-line CPU(s) list: 0-3
root@buildroot:~# cat /proc/cpuinfo
processor      : 0
hart          : 1
isa           : rv64imafdc
mmu           : sv39
isa-ext       :
uarch         : sifive,u74-mc

processor      : 1
hart          : 2
isa           : rv64imafdc
mmu           : sv39
isa-ext       :
uarch         : sifive,u74-mc

processor      : 2
hart          : 3
isa           : rv64imafdc
mmu           : sv39
isa-ext       :
uarch         : sifive,u74-mc

processor      : 3
hart          : 4
isa           : rv64imafdc
mmu           : sv39
isa-ext       :
uarch         : sifive,u74-mc
```

**RTF (4 threads)**

We use [csukuangfj/sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16](https://github.com/csukuangfj/sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16) (*Bilingual, Chinese + English*) for testing. The RTF is given below:

```
root@buildroot:next-gen-kaldi# cat run-sherpa-ncnn.sh
#!/usr/bin/env bash

./sherpa-ncnn \
./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/tokens.txt \
./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/encoder_jit_trace-pnnx.ncnn.param \
./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/encoder_jit_trace-pnnx.ncnn.bin \
./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/decoder_jit_trace-pnnx.ncnn.param \
./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/decoder_jit_trace-pnnx.ncnn.bin \
./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/joiner_jit_trace-pnnx.ncnn.param \
./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/joiner_jit_trace-pnnx.ncnn.bin \
./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/test_wavs/0.wav \
4 \
greedy_search

root@buildroot:next-gen-kaldi# ./run-sherpa-ncnn.sh
Don't Use GPU. has_gpu: 0, config.use_vulkan_compute: 1
RecognizerConfigfeat_config=FeatureExtractorConfig(sampling_rate=16000, feature_dim=80), model_config=ModelConfig(encoder_param="./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/encoder_jit_trace-pnnx.ncnn.param", encoder_bin="./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/encoder_jit_trace-pnnx.ncnn.bin", decoder_param="./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/decoder_jit_trace-pnnx.ncnn.param", decoder_bin="./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/decoder_jit_trace-pnnx.ncnn.bin", joiner_param="./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/joiner_jit_trace-pnnx.ncnn.param", joiner_bin="./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/joiner_jit_trace-pnnx.ncnn.bin", tokens="./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/tokens.txt", encoder_num_threads=4, decoder_num_threads=4, joiner_num_threads=4), decoder_config=DecoderConfig(method="greedy_search", num_active_paths=4), endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=True, min_trailing_silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_nonsilence=False, min_trailing_silence=1.4, min_utterance_length=0), rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_silence=0, min_utterance_length=20)), enable_endpoint=False)
wav filename: ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/test_wavs/0.wav
wav duration (s): 10.0531
Started!
Done!
Recognition result for ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/test_wavs/0.wav
text: 昨天是 MONDAY TODAY IS 李八二 TODAY AFTER TOMORROW 是星期三
timestamps: 0.64 1.08 1.6 2.08 2.24 2.36 4.04 4.28 5.12 5.48 5.68 6.12 6.8 6.96 7.28 7.92 8.04 8.2 8.28 9.04 9.36 9.6 10.04
Elapsed seconds: 9.334 s
Real time factor (RTF): 9.334 / 10.053 = 0.928
```

You can see that the RTF is less than 1, which means it is able to perform streaming (i.e., real-time) speech recognition.

The following posts the commands used for testing so that you can copy and paste them if you want to test it by yourself.

```
./sherpa-ncnn \
./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/tokens.txt \
./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/encoder_jit_ \
→trace-pnnx.ncnn.param \
./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/encoder_jit_ \
→trace-pnnx.ncnn.bin \
./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/decoder_jit_ \
→trace-pnnx.ncnn.param \
./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/decoder_jit_ \
→trace-pnnx.ncnn.bin \
./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/joiner_jit_trace- \
→pnnx.ncnn.param \
./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/joiner_jit_trace- \
→pnnx.ncnn.bin \
./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/test_wavs/0.wav \
4 \
greedy_search
```

## Real-time speech recognition with a microphone

Since the board does not have microphones, we use a USB microphone for testing.

**Caution:** We use the image from <https://huggingface.co/csukuangfj/visionfive2-sd-card-img/tree/main>, which provides support for USB microphones.

After connecting a USB microphone to the board, use the following command to check it:

```
root@buildroot:next-gen-kaldi# arecord -l
**** List of CAPTURE Hardware Devices ****
card 2: UACDemoV10 [UACDemoV1.0], device 0: USB Audio [USB Audio]
  Subdevices: 1/1
  Subdevice #0: subdevice #0
```

The output shows Card 2 and device 0, so the device name is `hw:2,0`.

The command to start the program for real-time speech recognition is

```
./sherpa-ncnn-alsa \
  ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/tokens.txt \
  ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/encoder_jit_
  ↪ trace-pnnx.ncnn.param \
  ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/encoder_jit_
  ↪ trace-pnnx.ncnn.bin \
  ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/decoder_jit_
  ↪ trace-pnnx.ncnn.param \
  ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/decoder_jit_
  ↪ trace-pnnx.ncnn.bin \
  ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/joiner_jit_trace-
  ↪ pnnx.ncnn.param \
  ./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/joiner_jit_trace-
  ↪ pnnx.ncnn.bin \
  hw:2,0 \
  4 \
  greedy_search
```

A screenshot is given below:

```
root@buildroot:next-gen-kaldi# ./run-sherpa-ncnn-alsa.sh
./sherpa-ncnn-alsa: /usr/lib/libasound.so.2: no version information available (required by ./sherpa-ncnn-alsa)
./sherpa-ncnn-alsa: /usr/lib/libasound.so.2: no version information available (required by ./sherpa-ncnn-alsa)
RecognizerConfigfeat_config=FeatureExtractorConfig(sampling_rate=16000, feature_dim=80), model_config=ModelConfig(encoder_param="./sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/encoder_jit_trace-pnnx.ncnn.param", encoder_bin=".sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/encoder_jit_trace-pnnx.ncnn.bin", decoder_param=".sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/decoder_jit_trace-pnnx.ncnn.param", decoder_bin=".sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/decoder_jit_trace-pnnx.ncnn.bin", joiner_param=".sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/64/joiner_jit_trace-pnnx.ncnn.param", joiner_bin=".sherpa-ncnn-streaming-zipformer-small-bilingual-zh-en-2023-02-16/tokens.txt", encoder_num_threads=4, decoder_num_threads=4, joiner_num_threads=4), decoder_config=DecoderConfig(method="greedy_search", num_active_paths=4), endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_trailing_silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_nonsilence=True, min_trailing_silence=1.2, min_utterance_length=0), rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_silence=0, min_utterance_length=300)), enable_endpoint=True)
Don't Use GPU. has_gpu: 0, config.use_vulkan_compute: 1
Failed to set sample rate to 16000
Current sample rate is 48000
Creating a resampler:
  in_sample_rate: 48000
  output_sample_rate: 16000
Recording started!
Use recording device: hw:2,0
0:星光二上的语音识别
1:这是一块基于 risk five
2:的开发版
```

## 7.11 FAQs

### 7.11.1 Where to get help

If you have any questions, please create an issue at <https://github.com/k2-fsa/sherpa-ncnn>

We also have active social groups:

- : Kaldi
- Kaldi, ,
- QQ 744602236

### 7.11.2 No default input device found

If you are using Linux and if `sherpa-ncnn-microphone` throws the following error:

```
Num device: 0
No default input device found.
```

Please consider using `sherpa-ncnn-alsa` to replace `sherpa-ncnn-microphone`. If you cannot find `sherpa-ncnn-alsa` in `./build/bin`, please run the following commands:

```
cd /path/to/sherpa-ncnn
sudo apt-get install alsa-utils libasound2-dev
cd build
rm CMakeCache.txt # Important, remove the cmake cache file
make -j
```

After the above commands, you should see a binary file `./build/bin/sherpa-ncnn-alsa`.

Please follow `sherpa-ncnn-alsa` to use `sherpa-ncnn-alsa`.

## **SHERPA-ONNX**

---

**Hint:** During speech recognition, it does not need to access the Internet. Everything is processed locally on your device.

---

We support using `onnx` with `onnxruntime` to replace `PyTorch` for neural network computation. The code is put in a separate repository `sherpa-onnx`.

`sherpa-onnx` is self-contained and everything can be compiled from source.

Please refer to <https://k2-fsa.github.io/icefall/model-export/export-onnx.html> for how to export models to `onnx` format.

In the following, we describe how to build `sherpa-onnx` for Linux, macOS, Windows, embedded systems, Android, and iOS.

Also, we show how to use it for speech recognition with pre-trained models.

### **8.1 Tutorials**

This page contains links to tutorials written by our users.

**Caution:** The tutorials are not necessarily written in English.

#### **8.1.1 (Chinese tutorials)**

##### **2024-05-09 sherpa-onnx**

<https://blog.csdn.net/smileac/article/details/138306277>

Windows

## **2024-04-09 rv1106&rv1109&rv1126sherpa-onnx TTS**

<https://it3q.com/article/223>.

gcc 32-bit arm sherpa-onnx, arm

## **2023-08-08 snowboy+kaldik2-fsasherpa-onnx**

<https://blog.csdn.net/anshichuxuezhe/article/details/132151456>.

Python API

## **2023-03-16 k2sherpa-onnx**

<https://www.bilibili.com/read/cv22438156/>.

## **8.2 Installation**

In this section, we describe how to install `sherpa-onnx` on various platforms.

### **Requirements:**

- CMake >= 3.13
- A compiler that supports at least C++14

---

**Hint:** You can use `pip install cmake` to install the latest cmake.

---

### **8.2.1 Linux**

This page describes how to build `sherpa-onnx` on Linux.

All you need is to run:

CPU

Nvidia GPU (CUDA)

```
git clone https://github.com/k2-fsa/sherpa-onnx
cd sherpa-onnx
mkdir build
cd build
cmake -DCMAKE_BUILD_TYPE=Release ..
make -j6
```

```
git clone https://github.com/k2-fsa/sherpa-onnx
cd sherpa-onnx
mkdir build
cd build
cmake -DCMAKE_BUILD_TYPE=Release -DBUILD_SHARED_LIBS=ON -DSHERPA_ONNX_ENABLE_GPU=ON ..
make -j6
```

---

**Hint:** You need to install CUDA toolkit. Otherwise, you would get errors at runtime.

You can refer to <https://k2-fsa.github.io/k2/installation/cuda-cudnn.html> to install CUDA toolkit.

---

After building, you will find an executable `sherpa-onnx` inside the `bin` directory.

That's it!

Please refer to *Pre-trained models* for a list of pre-trained models.

## 8.2.2 macOS

This page describes how to build `sherpa-onnx` on macOS.

---

**Hint:** It supports both Intel and Apple Silicon (e.g., M1).

---

All you need is to run:

```
git clone https://github.com/k2-fsa/sherpa-onnx
cd sherpa-onnx
mkdir build
cd build
cmake -DCMAKE_BUILD_TYPE=Release ..
make -j6
```

After building, you will find an executable `sherpa-onnx` inside the `bin` directory.

That's it!

Please refer to *Pre-trained models* for a list of pre-trained models.

## 8.2.3 Windows

This page describes how to build `sherpa-onnx` on Windows.

---

**Hint:** MinGW is known not to work. Please install Visual Studio before you continue.

---

**Note:** You can download pre-compiled binaries for both 32-bit and 64-bit Windows from the following URL <https://huggingface.co/csukuangfj/sherpa-onnx-libs/tree/main>.

Please always download the latest version.

URLs to download the version 1.9.12 is given below.

64-bit (static lib)	Windows	<a href="https://huggingface.co/csukuangfj/sherpa-onnx-libs/resolve/main/win64/sherpa-onnx-v1.9.12-win-x64-static.tar.bz2">https://huggingface.co/csukuangfj/sherpa-onnx-libs/resolve/main/win64/sherpa-onnx-v1.9.12-win-x64-static.tar.bz2</a>
64-bit (shared lib)	Windows	<a href="https://huggingface.co/csukuangfj/sherpa-onnx-libs/resolve/main/win64/sherpa-onnx-v1.9.12-win-x64-shared.tar.bz2">https://huggingface.co/csukuangfj/sherpa-onnx-libs/resolve/main/win64/sherpa-onnx-v1.9.12-win-x64-shared.tar.bz2</a>
32-bit (static lib)	Windows	<a href="https://huggingface.co/csukuangfj/sherpa-onnx-libs/resolve/main/win32/sherpa-onnx-v1.9.12-win-x86-static.tar.bz2">https://huggingface.co/csukuangfj/sherpa-onnx-libs/resolve/main/win32/sherpa-onnx-v1.9.12-win-x86-static.tar.bz2</a>
32-bit (shared lib)	Windows	<a href="https://huggingface.co/csukuangfj/sherpa-onnx-libs/resolve/main/win32/sherpa-onnx-v1.9.12-win-x86-shared.tar.bz2">https://huggingface.co/csukuangfj/sherpa-onnx-libs/resolve/main/win32/sherpa-onnx-v1.9.12-win-x86-shared.tar.bz2</a>

If you cannot access `huggingface.co`, then please replace `huggingface.co` with `hf-mirror.com`.

---

## 64-bit Windows (x64)

All you need is to run:

CPU

Nvidia GPU (CUDA)

```
git clone https://github.com/k2-fsa/sherpa-onnx
cd sherpa-onnx
mkdir build
cd build
cmake -DCMAKE_BUILD_TYPE=Release ..
cmake --build . --config Release
```

```
git clone https://github.com/k2-fsa/sherpa-onnx
cd sherpa-onnx
mkdir build
cd build
cmake -DCMAKE_BUILD_TYPE=Release -DBUILD_SHARED_LIBS=ON -DSHERPA_ONNX_ENABLE_GPU=ON ..
cmake --build . --config Release
```

---

**Hint:** You need to install CUDA toolkit. Otherwise, you would get errors at runtime.

---

After building, you will find an executable `sherpa-onnx.exe` inside the `bin/Release` directory.

That's it!

Please refer to *Pre-trained models* for a list of pre-trained models.

## 32-bit Windows (x86)

---

**Hint:** It does not support NVIDIA GPU for Win32/x86.

---

All you need is to run:

```

git clone https://github.com/k2-fsa/sherpa-onnx
cd sherpa-onnx
mkdir build
cd build

# Please select one toolset among VS 2015, 2017, 2019, and 2022 below
# We use VS 2022 as an example.

# For Visual Studio 2015
# cmake -T v140,host=x64 -A Win32 -D CMAKE_BUILD_TYPE=Release ..

# For Visual Studio 2017
# cmake -T v141,host=x64 -A Win32 -D CMAKE_BUILD_TYPE=Release ..

# For Visual Studio 2019
# cmake -T v142,host=x64 -A Win32 -D CMAKE_BUILD_TYPE=Release ..

# For Visual Studio 2022
cmake -T v143,host=x64 -A Win32 -D CMAKE_BUILD_TYPE=Release ..

cmake --build . --config Release -- -m:6

```

After building, you will find an executable `sherpa-onnx.exe` inside the `bin/Release` directory.

That's it!

Please refer to *Pre-trained models* for a list of pre-trained models.

**Hint:** By default, it builds static libraries of `sherpa-onnx`. To get dynamic/shared libraries, please pass `-DBUILD_SHARED_LIBS=ON` to `cmake`. That is, use

```
cmake -DCMAKE_BUILD_TYPE=Release -DBUILD_SHARED_LIBS=ON ..
```

## 8.2.4 Embedded Linux (aarch64)

This page describes how to build `sherpa-onnx` for embedded Linux (aarch64, 64-bit) with cross-compiling on an x64 machine with Ubuntu OS.

**Warning:** By cross-compiling we mean that you do the compilation on a x86\_64 machine. And you copy the generated binaries from a x86\_64 machine and run them on an aarch64 machine.

If you want to compile `sherpa-onnx` on an aarch64 machine directly, please see *Linux*.

**Note:** You can download pre-compiled binaries for aarch64 from the following URL <https://huggingface.co/csukuangfj/sherpa-onnx-libs/tree/main/aarch64>

Please always download the latest version.

Example command to download the version 1.9.12:

```
# binaries built with shared libraries
wget https://huggingface.co/csukuangfj/sherpa-onnéx-libs/resolve/main/aarch64/
↳sherpa-onnéx-v1.9.12-linux-aarch64-shared.tar.bz2

# binaries built with static link
wget https://huggingface.co/csukuangfj/sherpa-onnéx-libs/resolve/main/aarch64/
↳sherpa-onnéx-v1.9.12-linux-aarch64-static.tar.bz2

# For users from China
# huggingface,

# binaries built with shared libraries
wget https://hf-mirror.com/csukuangfj/sherpa-onnéx-libs/resolve/main/aarch64/
↳sherpa-onnéx-v1.9.12-linux-aarch64-shared.tar.bz2

# binaries built with static link
wget https://hf-mirror.com/csukuangfj/sherpa-onnéx-libs/resolve/main/aarch64/
↳sherpa-onnéx-v1.9.12-linux-aarch64-static.tar.bz2
```

---

**Hint:** We provide two colab notebooks for you to try this section step by step.

Build with shared libraries	Build with static libraries

If you are using Windows/macOS or you don't want to setup your local environment for cross-compiling, please use the above colab notebooks.

---

## Install toolchain

The first step is to install a toolchain for cross-compiling.

**Warning:** You can use any toolchain that is suitable for your platform. The toolchain we use below is just an example.

Visit <https://releases.linaro.org/components/toolchain/binaries/latest-7/aarch64-linux-gnu/>

We are going to download `gcc-linaro-7.5.0-2019.12-x86_64_aarch64-linux-gnu.tar.xz`, which has been uploaded to <https://huggingface.co/csukuangfj/sherpa-ncnn-toolchains>.

Assume you want to install it in the folder `$HOME/software`:

```
mkdir -p $HOME/software
cd $HOME/software
wget https://huggingface.co/csukuangfj/sherpa-ncnn-toolchains/resolve/main/gcc-linaro-7.
↳5.0-2019.12-x86_64_aarch64-linux-gnu.tar.xz

# For users from China
# huggingface,
```

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```
# wget https://hf-mirror.com/csukuangfj/sherpa-ncnn-toolchains/resolve/main/gcc-linaro-7.
˓→5.0-2019.12-x86_64_aarch64-linux-gnu.tar.xz
```

```
tar xvf gcc-linaro-7.5.0-2019.12-x86_64_aarch64-linux-gnu.tar.xz
```

Next, we need to set the following environment variable:

```
export PATH=$HOME/software/gcc-linaro-7.5.0-2019.12-x86_64_aarch64-linux-gnu/bin:$PATH
```

To check that we have installed the cross-compiling toolchain successfully, please run:

```
aarch64-linux-gnu-gcc --version
```

which should print the following log:

```
aarch64-linux-gnu-gcc (Linaro GCC 7.5-2019.12) 7.5.0
Copyright (C) 2017 Free Software Foundation, Inc.
This is free software; see the source for copying conditions. There is NO
warranty; not even for MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.
```

Congratulations! You have successfully installed a toolchain for cross-compiling `sherpa-onnx`.

## Build `sherpa-onnx`

Finally, let us build `sherpa-onnx`.

```
git clone https://github.com/k2-fsa/sherpa-onnx
cd sherpa-onnx
export BUILD_SHARED_LIBS=ON
./build-aarch64-linux-gnu.sh
```

After building, you will get two binaries:

```
sherpa-onnx$ ls -lh build-aarch64-linux-gnu/install/bin/
total 378K
-rwxr-xr-x 1 kuangfangjun root 187K Feb 21 21:55 sherpa-onnx
-rwxr-xr-x 1 kuangfangjun root 191K Feb 21 21:55 sherpa-onnx-alsa
```

---

**Note:** Please also copy the `onnxruntime` lib to your embedded systems and put it into the same directory as `sherpa-onnx` and `sherpa-onnx-alsa`.

```
sherpa-onnx$ ls -lh build-aarch64-linux-gnu/install/lib/*onnxruntime*
lrw-r--r-- 1 kuangfangjun root 24 Feb 21 21:38 build-aarch64-linux-gnu/install/lib/
˓→libonnxruntime.so -> libonnxruntime.so.1.14.0
-rw-r--r-- 1 kuangfangjun root 15M Feb 21 21:38 build-aarch64-linux-gnu/install/lib/
˓→libonnxruntime.so.1.14.0
```

---

That's it!

---

**Hint:**

- `sherpa-onnx` is for decoding a single file
  - `sherpa-onnx-alsa` is for real-time speech recognition by reading the microphone with [ALSA](#)
- 

### sherpa-onnx-alsa

**Caution:** We recommend that you use `sherpa-onnx-alsa` on embedded systems such as Raspberry pi.

You need to provide a `device_name` when invoking `sherpa-onnx-alsa`. We describe below how to find the device name for your microphone.

Run the following command:

```
arecord -l
```

to list all available microphones for recording. If it complains that `arecord`: command not found, please use `sudo apt-get install alsa-utils` to install it.

If the above command gives the following output:

```
**** List of CAPTURE Hardware Devices ****
card 3: UACDemoV10 [UACDemoV1.0], device 0: USB Audio [USB Audio]
  Subdevices: 1/1
  Subdevice #0: subdevice #0
```

In this case, I only have 1 microphone. It is `card 3` and that card has only `device 0`. To select `card 3` and `device 0` on that card, we need to pass `plughw:3,0` to `sherpa-onnx-alsa`. (Note: It has the format `plughw:card_number,device_index`.)

For instance, you have to use

```
./sherpa-onnx-alsa \
  --encoder=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/
  --encoder-epoch-99-avg-1.onnx \
  --decoder=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/
  --decoder-epoch-99-avg-1.onnx \
  --joiner=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/
  --joiner-epoch-99-avg-1.onnx \
  --tokens=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/
  --tokens.txt \
  plughw:3,0
```

Please change the card number and also the device index on the selected card accordingly in your own situation. Otherwise, you won't be able to record with your microphone.

Please read [Pre-trained models](#) for usages about the generated binaries.

---

**Hint:** If you want to select a pre-trained model for Raspberry that can be run on real-time, we recommend you to use [Zipformer-transducer-based Models](#).

---

Please create an issue at <https://github.com/k2-fsa/sherpa-onnx/issues> if you have any problems.

## How to build static libraries and static linked binaries

If you want to build static libraries and static linked binaries, please first download a cross compile toolchain with GCC  $\geq 9.0$ . The following is an example:

```
mkdir -p $HOME/software
cd $HOME/software
wget -q https://huggingface.co/csukuangfj/sherpa-ncnn-toolchains/resolve/main/gcc-arm-10.
→3-2021.07-x86_64-aarch64-none-linux-gnu.tar.xz

# For users from China
# huggingface,
# wget -q https://hf-mirror.com/csukuangfj/sherpa-ncnn-toolchains/resolve/main/gcc-arm-
→10.3-2021.07-x86_64-aarch64-none-linux-gnu.tar.xz

tar xf gcc-arm-10.3-2021.07-x86_64-aarch64-none-linux-gnu.tar.xz
```

Next, we need to set the following environment variable:

```
export PATH=$HOME/software/gcc-arm-10.3-2021.07-x86_64-aarch64-none-linux-gnu/bin:$PATH
```

To check that we have installed the cross-compiling toolchain successfully, please run:

```
aarch64-none-linux-gnu-gcc --version
```

which should print the following log:

```
aarch64-none-linux-gnu-gcc (GNU Toolchain for the A-profile Architecture 10.3-2021.07
→(arm-10.29)) 10.3.1 20210621
Copyright (C) 2020 Free Software Foundation, Inc.
This is free software; see the source for copying conditions. There is NO
warranty; not even for MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.
```

Now you can build static libraries and static linked binaries with the following commands:

```
git clone https://github.com/k2-fsa/sherpa-onnx
cd sherpa-onnx
export BUILD_SHARED_LIBS=OFF
./build-aarch64-linux-gnu.sh
```

You can use the following commands to check that the generated binaries are indeed static linked:

```
$ cd build-aarch64-linux-gnu/bin

$ ldd sherpa-onnéx-alsa
    not a dynamic executable

$ readelf -d sherpa-onnéx-alsa

Dynamic section at offset 0xed9950 contains 30 entries:
  Tag          Type           Name/Value
  0x0000000000000001 (NEEDED)  Shared library: [libasound.so.2]
  0x0000000000000001 (NEEDED)  Shared library: [libdl.so.2]
  0x0000000000000001 (NEEDED)  Shared library: [libm.so.6]
```

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0x0000000000000001 (NEEDED)	Shared library: [libpthread.so.0]
0x0000000000000001 (NEEDED)	Shared library: [libc.so.6]
0x000000000000000f (RPATH)	Library rpath: [\$ORIGIN:/star-fj/fangjun/open- source/sherpa-onnx/build-aarch64-linux-gnu/_deps/onnxruntime-sr c/lib:]
0x000000000000000c (INIT)	0x404218

## 8.2.5 Embedded Linux (arm)

This page describes how to build `sherpa-onnx` for embedded Linux (arm, 32-bit) with cross-compiling on an x86 machine with Ubuntu OS.

**Caution:** If you want to build `sherpa-onnx` directly on your board, please don't use this document. Refer to [Linux](#) instead.

**Caution:** If you want to build `sherpa-onnx` directly on your board, please don't use this document. Refer to [Linux](#) instead.

**Caution:** If you want to build `sherpa-onnx` directly on your board, please don't use this document. Refer to [Linux](#) instead.

**Hint:** This page is for cross-compiling.

**Note:** You can download pre-compiled binaries for 32-bit ARM from the following URL <https://huggingface.co/csukuangfj/sherpa-onnx-libs/tree/main/arm32>

Please always download the latest version.

Example command to download the version 1.9.12:

```
# binaries built with shared libraries
wget https://huggingface.co/csukuangfj/sherpa-onnx-libs/resolve/main/arm32/
  ↳sherpa-onnx-v1.9.12-linux-arm-gnueabihf-shared.tar.bz2

# binaries built with static link
wget https://huggingface.co/csukuangfj/sherpa-onnx-libs/resolve/main/arm32/
  ↳sherpa-onnx-v1.9.12-linux-arm-gnueabihf-static.tar.bz2

# For users from China
#   huggingface,

# binaries built with shared libraries
wget https://hf-mirror.com/csukuangfj/sherpa-onnx-libs/resolve/main/arm32/
  ↳sherpa-onnx-v1.9.12-linux-arm-gnueabihf-shared.tar.bz2
```

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```
# binaries built with static link
wget https://hf-mirror.com/csukuangfj/sherpa-onnx-libs/resolve/main/arm32/
↳sherpa-onnx-v1.9.12-linux-arm-gnueabihf-static.tar.bz2
```

**Hint:** We provide two colab notebooks for you to try this section step by step.

Build with shared libraries	Build with static libraries

If you are using Windows/macOS or you don't want to setup your local environment for cross-compiling, please use the above colab notebooks.

## Install toolchain

The first step is to install a toolchain for cross-compiling.

**Warning:** You can use any toolchain that is suitable for your platform. The toolchain we use below is just an example.

Visit <https://developer.arm.com/downloads/-/arm-gnu-toolchain-downloads> to download the toolchain:

We are going to download `gcc-arm-10.3-2021.07-x86_64-arm-none-linux-gnueabihf.tar.xz`, which has been uploaded to <https://huggingface.co/csukuangfj/sherpa-ncnn-toolchains>.

Assume you want to install it in the folder `$HOME/software`:

```
mkdir -p $HOME/software
cd $HOME/software
wget -q https://huggingface.co/csukuangfj/sherpa-ncnn-toolchains/resolve/main/gcc-arm-10.
↳3-2021.07-x86_64-arm-none-linux-gnueabihf.tar.xz

# For users from China
# huggingface,
# wget -q https://hf-mirror.com/csukuangfj/sherpa-ncnn-toolchains/resolve/main/gcc-arm-
↳10.3-2021.07-x86_64-arm-none-linux-gnueabihf.tar.xz

tar xf gcc-arm-10.3-2021.07-x86_64-arm-none-linux-gnueabihf.tar.xz
```

Next, we need to set the following environment variable:

```
export PATH=$HOME/software/gcc-arm-10.3-2021.07-x86_64-arm-none-linux-gnueabihf/bin:$PATH
```

To check that we have installed the cross-compiling toolchain successfully, please run:

```
arm-none-linux-gnueabihf-gcc --version
```

which should print the following log:

```
arm-none-linux-gnueabihf-gcc (GNU Toolchain for the A-profile Architecture 10.3-2021.07
 ↳(arm-10.29)) 10.3.1 20210621
Copyright (C) 2020 Free Software Foundation, Inc.
This is free software; see the source for copying conditions. There is NO
warranty; not even for MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.
```

Congratulations! You have successfully installed a toolchain for cross-compiling `sherpa-onnx`.

## Build `sherpa-onnx`

Finally, let us build `sherpa-onnx`.

```
git clone https://github.com/k2-fsa/sherpa-onnx
cd sherpa-onnx
export BUILD_SHARED_LIBS=ON
./build-arm-linux-gnueabihf.sh
```

After building, you will get the following binaries:

```
$ ls -lh build-arm-linux-gnueabihf/install/bin/
total 1.2M
-rwxr-xr-x 1 kuangfangjun root 395K Jul 7 16:28 sherpa-onnx
-rwxr-xr-x 1 kuangfangjun root 391K Jul 7 16:28 sherpa-onnx-alsa
-rwxr-xr-x 1 kuangfangjun root 351K Jul 7 16:28 sherpa-onnx-offline
```

That's it!

---

### Hint:

- `sherpa-onnx` is for decoding a single file using a streaming model
  - `sherpa-onnx-offline` is for decoding a single file using a non-streaming model
  - `sherpa-onnx-alsa` is for real-time speech recognition using a streaming model by reading the microphone with [ALSA](#)
- 

**Caution:** We recommend that you use `sherpa-onnx-alsa` on embedded systems such as Raspberry pi.

You need to provide a `device_name` when invoking `sherpa-onnx-alsa`. We describe below how to find the device name for your microphone.

Run the following command:

```
arecord -l
```

to list all available microphones for recording. If it complains that `arecord`: command not found, please use `sudo apt-get install alsa-utils` to install it.

If the above command gives the following output:

```
**** List of CAPTURE Hardware Devices ****
card 0: Audio [Axera Audio], device 0: 49ac000.i2s_mst-es8328-hifi-analog
 ↳es8328-hifi-analog-0 []
Subdevices: 1/1
Subdevice #0: subdevice #0
```

In this case, I only have 1 microphone. It is card 0 and that card has only device 0. To select card 0 and device 0 on that card, we need to pass `plughw:0,0` to `sherpa-onnx-alsa`. (Note: It has the format `plughw:card_number,device_index`.)

For instance, you have to use

```
# Note: We use int8 models below.
./bin/sherpa-onnx-alsa \
  ./sherpa-onnx-streaming-zipformer-en-2023-06-26/tokens.txt \
  ./sherpa-onnx-streaming-zipformer-en-2023-06-26/encoder-epoch-99-avg-1-
  ↵chunk-16-left-64.int8.onnx \
  ./sherpa-onnx-streaming-zipformer-en-2023-06-26/decoder-epoch-99-avg-1-
  ↵chunk-16-left-64.int8.onnx \
  ./sherpa-onnx-streaming-zipformer-en-2023-06-26/joiner-epoch-99-avg-1-
  ↵chunk-16-left-64.int8.onnx \
  "plughw:0,0"
```

Please change the card number and also the device index on the selected card accordingly in your own situation. Otherwise, you won't be able to record with your microphone.

Please read [Pre-trained models](#) for usages about the generated binaries.

Read below if you want to learn more.

**Hint:** By default, all external dependencies are statically linked. That means, the generated binaries are self-contained (except that it requires the onnxruntime shared library at runtime).

You can use the following commands to check that and you will find they depend only on system libraries.

```
$ readelf -d build-arm-linux-gnueabihf/install/bin/sherpa-onnx

Dynamic section at offset 0x61ee8 contains 30 entries:
  Tag          Type           Name/Value
  0x00000001 (NEEDED)      Shared library: [libonnxruntime.so.
  ↵1.14.0]
  0x00000001 (NEEDED)      Shared library: [libstdc++.so.6]
  0x00000001 (NEEDED)      Shared library: [libm.so.6]
  0x00000001 (NEEDED)      Shared library: [libgcc_s.so.1]
  0x00000001 (NEEDED)      Shared library: [libc.so.6]
  0x0000000f (RPATH)       Library rpath: [$ORIGIN:$ORIGIN/...
  ↵lib:$ORIGIN/../../../../sherpa_onnx/lib]

$ readelf -d build-arm-linux-gnueabihf/install/bin/sherpa-onnx-alsa

Dynamic section at offset 0x60ee0 contains 31 entries:
  Tag          Type           Name/Value
  0x00000001 (NEEDED)      Shared library: [libasound.so.2]
  0x00000001 (NEEDED)      Shared library: [libonnxruntime.so.
  ↵1.14.0]
  0x00000001 (NEEDED)      Shared library: [libstdc++.so.6]
  0x00000001 (NEEDED)      Shared library: [libm.so.6]
  0x00000001 (NEEDED)      Shared library: [libgcc_s.so.1]
  0x00000001 (NEEDED)      Shared library: [libc.so.6]
  0x0000000f (RPATH)       Library rpath: [$ORIGIN]
```

Please create an issue at <https://github.com/k2-fsa/sherpa-onnéx/issues> if you have any problems.

## How to build static libraries and static linked binaries

If you want to build static libraries and static linked binaries, please first download a cross compile toolchain with GCC  $\geq 9.0$ . The following is an example:

```
mkdir -p $HOME/software
cd $HOME/software
wget -q https://huggingface.co/csukuangfj/sherpa-ncnn-toolchains/resolve/main/gcc-arm-10.
↪3-2021.07-x86_64-arm-none-linux-gnueabihf.tar.xz

# For users from China
# huggingface,
wget -q https://hf-mirror.com/csukuangfj/sherpa-ncnn-toolchains/resolve/main/gcc-arm-10.
↪3-2021.07-x86_64-arm-none-linux-gnueabihf.tar.xz

tar xf gcc-arm-10.3-2021.07-x86_64-arm-none-linux-gnueabihf.tar.xz
```

Next, we need to set the following environment variable:

```
export PATH=$HOME/software/gcc-arm-10.3-2021.07-x86_64-arm-none-linux-gnueabihf/bin:$PATH
```

To check that we have installed the cross-compiling toolchain successfully, please run:

```
arm-none-linux-gnueabihf-gcc --version
```

which should print the following log:

```
arm-none-linux-gnueabihf-gcc (GNU Toolchain for the A-profile Architecture 10.3-2021.07
↪(arm-10.29)) 10.3.1 20210621
Copyright (C) 2020 Free Software Foundation, Inc.
This is free software; see the source for copying conditions. There is NO
warranty; not even for MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.
```

Now you can build static libraries and static linked binaries with the following commands:

```
git clone https://github.com/k2-fsa/sherpa-onnéx
cd sherpa-onnéx
export BUILD_SHARED_LIBS=OFF
./build-arm-linux-gnueabihf.sh
```

You can use the following commands to check that the generated binaries are indeed static linked:

```
$ cd build-arm-linux-gnueabihf/bin

$ ldd sherpa-onnéx-alsa
    not a dynamic executable

$ readelf -d sherpa-onnéx-alsa

Dynamic section at offset 0xa68eb4 contains 31 entries:
```

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Tag	Type	Name/Value
0x00000001	(NEEDED)	Shared library: [libasound.so.2]
0x00000001	(NEEDED)	Shared library: [libdl.so.2]
0x00000001	(NEEDED)	Shared library: [libm.so.6]
0x00000001	(NEEDED)	Shared library: [libpthread.so.0]
0x00000001	(NEEDED)	Shared library: [libc.so.6]
0x00000001	(NEEDED)	Shared library: [ld-linux-armhf.so.3]
0x0000000f	(RPATH)	Library rpath: [\$ORIGIN:/star-fj/fangjun/open- -source/sherpa-onnx/build-arm-linux-gnueabihf/_deps/espeak_ng-src/lib:/star-fj/fangjun/ -open-source/sherpa-onnx/build-arm-linux-gnueabihf/_deps/onnxruntime-src/lib:]
0x0000000c	(INIT)	0x13550

## 8.2.6 Embedded Linux (riscv64)

This page describes how to build `sherpa-onnx` for embedded Linux (RISC-V, 64-bit) with cross-compiling on an x64 machine with Ubuntu OS. It also demonstrates how to use `qemu` to run the compiled binaries.

**Hint:** We provide a colab notebook for you to try this section step by step.

If you are using Windows/macOS or you don't want to setup your local environment for cross-compiling, please use the above colab notebook.

**Note:** You can download pre-compiled binaries for `riscv64` from the following URL <https://huggingface.co/csukuangfj/sherpa-onnx-libs/tree/main/riscv64>

Please always download the latest version.

Example command to download the version 1.9.12:

```
# binaries built with shared libraries
wget https://huggingface.co/csukuangfj/sherpa-onnx-libs/resolve/main/riscv64/
  ->sherpa-onnx-v1.9.12-linux-riscv64-shared.tar.bz2

# For users from China
# huggingface,

# binaries built with shared libraries
# wget https://hf-mirror.com/csukuangfj/sherpa-onnx-libs/resolve/main/riscv64/
  ->sherpa-onnx-v1.9.12-linux-riscv64-shared.tar.bz2
```

## Install toolchain

The first step is to install a toolchain for cross-compiling.

```
mkdir -p $HOME/toolchain

wget -q https://occ-oss-prod.oss-cn-hangzhou.aliyuncs.com/resource//1663142514282/
↳ Xuantie-900-gcc-linux-5.10.4-glibc-x86_64-V2.6.1-20220906.tar.gz

tar xf ./Xuantie-900-gcc-linux-5.10.4-glibc-x86_64-V2.6.1-20220906.tar.gz --strip-
↳ components 1 -C $HOME/toolchain
```

Next, we need to set the following environment variable:

```
export PATH=$HOME/toolchain/bin:$PATH
```

To check that you have installed the toolchain successfully, please run

```
$ riscv64-unknown-linux-gnu-gcc --version

riscv64-unknown-linux-gnu-gcc (Xuantie-900 linux-5.10.4 glibc gcc Toolchain V2.6.1 B-
↳ 20220906) 10.2.0
Copyright (C) 2020 Free Software Foundation, Inc.
This is free software; see the source for copying conditions. There is NO
warranty; not even for MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.

$ riscv64-unknown-linux-gnu-g++ --version

riscv64-unknown-linux-gnu-g++ (Xuantie-900 linux-5.10.4 glibc gcc Toolchain V2.6.1 B-
↳ 20220906) 10.2.0
Copyright (C) 2020 Free Software Foundation, Inc.
This is free software; see the source for copying conditions. There is NO
warranty; not even for MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.
```

## Build sherpa-onnx

Next, let us build [sherpa-onnx](#).

---

**Hint:** Currently, only shared libraries are supported. We will support static linking in the future.

---

```
git clone https://github.com/k2-fsa/sherpa-onnx
cd sherpa-onnx
./build-riscv64-linux-gnu.sh
```

After building, you will get the following files

```
$ ls -lh build-riscv64-linux-gnu/install/bin
$ echo "---"
$ ls -lh build-riscv64-linux-gnu/install/lib
total 292K
```

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```

-rwxr-xr-x 1 root root 23K Mar 20 09:41 sherpa-onnx
-rwxr-xr-x 1 root root 27K Mar 20 09:41 sherpa-onnx-alsa
-rwxr-xr-x 1 root root 31K Mar 20 09:41 sherpa-onnx-alsa-offline
-rwxr-xr-x 1 root root 40K Mar 20 09:41 sherpa-onnx-alsa-offline-speaker-identification
-rwxr-xr-x 1 root root 23K Mar 20 09:41 sherpa-onnx-keyword-spotter
-rwxr-xr-x 1 root root 27K Mar 20 09:41 sherpa-onnx-keyword-spotter-alsa
-rwxr-xr-x 1 root root 23K Mar 20 09:41 sherpa-onnx-offline
-rwxr-xr-x 1 root root 39K Mar 20 09:41 sherpa-onnx-offline-parallel
-rwxr-xr-x 1 root root 19K Mar 20 09:41 sherpa-onnx-offline-tts
-rwxr-xr-x 1 root root 31K Mar 20 09:41 sherpa-onnx-offline-tts-play-alsa
---
total 30M
-rw-r--r-- 1 root root 256K Mar 20 09:41 libespeak-ng.so
-rw-r--r-- 1 root root 71K Mar 20 09:41 libkaldi-decoder-core.so
-rw-r--r-- 1 root root 67K Mar 20 09:41 libkaldi-native-fbank-core.so
-rw-r--r-- 1 root root 13M Mar 20 09:35 libonnxruntime.so
-rw-r--r-- 1 root root 13M Mar 20 09:35 libonnxruntime.so.1.14.1
lrwxrwxrwx 1 root root 23 Mar 20 09:41 libpiper_phonemize.so -> libpiper_phonemize.
so.1
lrwxrwxrwx 1 root root 27 Mar 20 09:41 libpiper_phonemize.so.1 -> libpiper_phonemize.
so.1.2.0
-rw-r--r-- 1 root root 395K Mar 20 09:41 libpiper_phonemize.so.1.2.0
-rw-r--r-- 1 root root 1.3M Mar 20 09:41 libsherpa-onnx-core.so
lrwxrwxrwx 1 root root 23 Mar 20 09:41 libsherpa-onnx-fst.so -> libsherpa-onnx-fst.
so.6
-rw-r--r-- 1 root root 1.4M Mar 20 09:41 libsherpa-onnx-fst.so.6
-rw-r--r-- 1 root root 752K Mar 20 09:41 libsherpa-onnx-kaldifst-core.so
-rw-r--r-- 1 root root 202K Mar 20 09:41 libucd.so
drwxr-xr-x 2 root root 4.0K Mar 20 09:41 pkgconfig

```

```
$ file build-riscv64-linux-gnu/install/bin/sherpa-onnx
```

```
build-riscv64-linux-gnu/install/bin/sherpa-onnx: ELF 64-bit LSB executable, UCB RISC-V, ↵
RVC, double-float ABI, version 1 (GNU/Linux), dynamically linked, interpreter /lib/ld- ↵
linux-riscv64-lp64d.so.1, for GNU/Linux 4.15.0, stripped
```

```
$ readelf -d build-riscv64-linux-gnu/install/bin/sherpa-onnx
```

```
$ find $HOME/toolchain/ -name ld-linux-riscv64-lp64d.so.1

  Dynamic section at offset 0x4d40 contains 39 entries:
    Tag          Type           Name/Value
    0x0000000000000001 (NEEDED)  Shared library: [libsherpa-onnx-core.so]
    0x0000000000000001 (NEEDED)  Shared library: [libkaldi-native-fbank-core.
so]
    0x0000000000000001 (NEEDED)  Shared library: [libkaldi-decoder-core.so]
    0x0000000000000001 (NEEDED)  Shared library: [libsherpa-onnx-kaldifst-
core.so]
    0x0000000000000001 (NEEDED)  Shared library: [libsherpa-onnx-fst.so.6]
    0x0000000000000001 (NEEDED)  Shared library: [libpiper_phonemize.so.1]
    0x0000000000000001 (NEEDED)  Shared library: [libonnxruntime.so.1.14.1]
```

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0x0000000000000001 (NEEDED)	Shared library: [libespeak-ng.so]
0x0000000000000001 (NEEDED)	Shared library: [libucd.so]
0x0000000000000001 (NEEDED)	Shared library: [libstdc++.so.6]
0x0000000000000001 (NEEDED)	Shared library: [libm.so.6]
0x0000000000000001 (NEEDED)	Shared library: [libgcc_s.so.1]
0x0000000000000001 (NEEDED)	Shared library: [libpthread.so.0]
0x0000000000000001 (NEEDED)	Shared library: [libc.so.6]
0x000000000000000f (RPATH)	Library rpath: [\$ORIGIN:\$ORIGIN/../lib:
→\$ORIGIN/../../../../sherpa_onnéx/lib]	
0x0000000000000020 (PREINIT_ARRAY)	0x15d20
0x0000000000000021 (PREINIT_ARRAYSZ)	8 (bytes)
0x0000000000000019 (INIT_ARRAY)	0x15d28
0x000000000000001b (INIT_ARRAYSZ)	16 (bytes)
0x000000000000001a (FINI_ARRAY)	0x15d38
0x000000000000001c (FINI_ARRAYSZ)	8 (bytes)
0x0000000000000004 (HASH)	0x10280
0x000000006ffffef5 (GNU_HASH)	0x10418
0x0000000000000005 (STRTAB)	0x10bd8
0x0000000000000006 (SYMTAB)	0x105f0
0x000000000000000a (STRSZ)	3652 (bytes)
0x000000000000000b (SYMENT)	24 (bytes)
0x0000000000000015 (DEBUG)	0x0
0x0000000000000003 (PLTGOT)	0x16000
0x0000000000000002 (PLTRELSZ)	1056 (bytes)
0x0000000000000014 (PLTREL)	RELA
0x0000000000000017 (JMPREL)	0x11bb0
0x0000000000000007 (RELA)	0x11b80
0x0000000000000008 (RELASZ)	1104 (bytes)
0x0000000000000009 (RELAENT)	24 (bytes)
0x000000006fffffe (VERNEED)	0x11aa0
0x000000006fffffff (VERNEEDNUM)	4
0x000000006fffff0 (VERSYM)	0x11a1c
0x0000000000000000 (NULL)	0x0
/root/toolchain/sysroot/lib/ld-linux-riscv64-1p64d.so.1	

That's it!

Please create an issue at <https://github.com/k2-fsa/sherpa-onnéx/issues> if you have any problems.

Read more if you want to run the binaries with qemu.

## qemu

**Hint:** This subsection works only on x64 Linux.

**Caution:** Please don't use any other methods to install qemu-riscv64. Only the method listed in this subsection is known to work.

Please use the following command to download the qemu-riscv64 binary.

```

mkdir -p $HOME/qemu

mkdir -p /tmp
cd /tmp
wget -q https://files.pythonhosted.org/packages/21/f4/
↳ 733f29c435987e8bb264a6504c7a4ea4c04d0d431b38a818ab63eef082b9/xuantie_qemu-20230825-py3-
↳ none-manylinux1_x86_64.whl

unzip xuantie_qemu-20230825-py3-none-manylinux1_x86_64.whl
cp -v ./qemu/qemu-riscv64 $HOME/qemu

export PATH=$HOME/qemu:$PATH

```

To check that we have installed `qemu-riscv64` successfully, please run:

```
qemu-riscv64 -h
```

which should give the following output:

```

usage: qemu-riscv64 [options] program [arguments...]
Linux CPU emulator (compiled for riscv64 emulation)

Options and associated environment variables:

Argument          Env-variable      Description
-h                print this help
--help
--g port          QEMU_GDB        wait gdb connection to 'port'
--L path          QEMU_LD_PREFIX  set the elf interpreter prefix to 'path'
--s size          QEMU_STACK_SIZE  set the stack size to 'size' bytes
--cpu model       QEMU_CPU        select CPU (-cpu help for list)
--E var=value     QEMU_SET_ENV   sets targets environment variable (see below)
--U var           QEMU_UNSET_ENV  unsets targets environment variable (see below)
--@ argv@          QEMU_ARGV@     forces target process argv[0] to be 'argv@'
--r uname          QEMU_UNAME     set qemu uname release string to 'uname'
--B address        QEMU_GUEST_BASE  set guest_base address to 'address'
--R size          QEMU_RESERVED_VA reserve 'size' bytes for guest virtual address
--space
--d item[,...]    QEMU_LOG       enable logging of specified items (use '-d help' for a list of items)
--dfilter range[,...] QEMU_DFILTER  filter logging based on address range
--D logfile        QEMU_LOG_FILENAME write logs to 'logfile' (default stderr)
--p pagesize       QEMU_PAGESIZE  set the host page size to 'pagesize'
--singlestep      QEMU_SINGLESTEP run in singlestep mode
--strace          QEMU_STRACE    log system calls
--pctrace         QEMU_PCTRACE   log pctrace
--seed             QEMU_RAND_SEED  Seed for pseudo-random number generator
--trace            QEMU_TRACE     [[enable=<pattern>][,events=<file>][,file=<file>]
--csky-extend     CSKY_EXTEND    [tb_trace=<on|off>][,jcount_start=<addr>][,jcount_
--end=<addr>][vdsp=<vdsp>][exit_addr=<addr>][denormal=<on|off>]
--CPF             CSKY_PROFILING
--csky-trace      CSKY_TRACE     [port=<port>][,tb_trace=<on|off>][,mem_trace=
--<on|off>][,auto_trace=<on|off>][,start=addr][,exit=addr]

```

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```
-plugin          QEMU_PLUGIN      [file=>] <file>[,arg=<string>]  
-version         QEMU_VERSION     display version information and exit
```

Defaults:

```
QEMU_LD_PREFIX  = /usr/gnemu/qemu-riscv64  
QEMU_STACK_SIZE = 8388608 byte
```

You can use `-E` and `-U` options or the `QEMU_SET_ENV` and `QEMU_UNSET_ENV` environment variables to set and unset environment variables for the target process.

It is possible to provide several variables by separating them by commas in `getsubopt(3)` style. Additionally it is possible to provide the `-E` and `-U` options multiple times.

The following lines are equivalent:

```
-E var1=val2 -E var2=val2 -U LD_PRELOAD -U LD_DEBUG  
-E var1=val2,var2=val2 -U LD_PRELOAD,LD_DEBUG  
QEMU_SET_ENV=var1=val2,var2=val2 QEMU_UNSET_ENV=LD_PRELOAD,LD_DEBUG
```

Note that if you provide several changes to a single variable the last change will stay in effect.

See <<https://qemu.org/contribute/report-a-bug>> for how to report bugs.  
More information on the QEMU project at <<https://qemu.org>>.

We describe below how to use `qemu-riscv64` to run speech-to-text and text-to-speech.

## Run speech-to-text with qemu

We use [csukuangfj/sherpa-onnx-streaming-zipformer-en-20M-2023-02-17 \(English\)](https://github.com/csukuangfj/sherpa-onnx-streaming-zipformer-en-20M-2023-02-17) as the test model.

**Note:** You can select any model from *Pre-trained models*.

Please use the following command to download the model:

```
cd /path/to/sherpa-onnx  
  
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-  
streaming-zipformer-en-20M-2023-02-17.tar.bz2  
tar xvf sherpa-onnx-streaming-zipformer-en-20M-2023-02-17.tar.bz2  
rm sherpa-onnx-streaming-zipformer-en-20M-2023-02-17.tar.bz2
```

Now you can use the following command to run it with `qemu-riscv64`:

```
cd /path/to/sherpa-onnx  
  
export PATH=$HOME/qemu:$PATH  
  
qemu-riscv64 build-riscv64-linux-gnu/install/bin/sherpa-onnx \  
--tokens=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/tokens.txt \  
--encoder=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/encoder-epoch-99-avg-1. \  
onnx \  
onnx
```

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```
--decoder=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/decoder-epoch-99-avg-1.
˓→onnx \
--joiner=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/joiner-epoch-99-avg-1.
˓→onnx \
./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/test_wavs/0.wav
```

It will throw the following error:

```
qemu-riscv64: Could not open '/lib/ld-linux-riscv64-lp64d.so.1': No such file or
˓→directory
```

Please use the following command instead:

```
cd /path/to/sherpa-onnx

export PATH=$HOME/qemu:$PATH
export QEMU_LD_PREFIX=$HOME/toolchain/sysroot

qemu-riscv64 build-riscv64-linux-gnu/install/bin/sherpa-onnx \
--tokens=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/tokens.txt \
--encoder=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/encoder-epoch-99-avg-1.
˓→onnx \
--decoder=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/decoder-epoch-99-avg-1.
˓→onnx \
--joiner=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/joiner-epoch-99-avg-1.
˓→onnx \
./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/test_wavs/0.wav
```

It will throw a second error:

```
build-riscv64-linux-gnu/install/bin/sherpa-onnx: error while loading shared libraries: \
˓→ld-linux-riscv64xthead-lp64d.so.1: cannot open shared object file: No such file or
˓→directory
```

Please use the following command instead:

```
cd /path/to/sherpa-onnx

export PATH=$HOME/qemu:$PATH
export QEMU_LD_PREFIX=$HOME/toolchain/sysroot
export LD_LIBRARY_PATH=$HOME/toolchain/sysroot/lib:$LD_LIBRARY_PATH

qemu-riscv64 build-riscv64-linux-gnu/install/bin/sherpa-onnx \
--tokens=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/tokens.txt \
--encoder=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/encoder-epoch-99-avg-1.
˓→onnx \
--decoder=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/decoder-epoch-99-avg-1.
˓→onnx \
--joiner=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/joiner-epoch-99-avg-1.
˓→onnx \
./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/test_wavs/0.wav
```

Finally, it prints the following output:

```
/content/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 build-riscv64-linux-gnu/
↳ install/bin/sherpa-onnx --tokens=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/
↳ tokens.txt --encoder=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/encoder-epoch-
↳ 99-avg-1.onnx --decoder=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/decoder-
↳ epoch-99-avg-1.onnx --joiner=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/
↳ joiner-epoch-99-avg-1.onnx ./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/test_
↳ wavs/0.wav

OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_
↳ dim=80), model_config=OnlineModelConfig(transducer=OnlineTransducerModelConfig(encoder=
↳ "./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/encoder-epoch-99-avg-1.onnx",_
↳ decoder="./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/decoder-epoch-99-avg-1.
↳ onnx", joiner="./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/joiner-epoch-99-avg-
↳ 1.onnx"), paraformer=OnlineParaformerModelConfig(encoder="", decoder ""), wenet_
↳ ctc=OnlineWenetCtcModelConfig(model="", chunk_size=16, num_left_chunks=4), zipformer2_
↳ ctc=OnlineZipformer2CtcModelConfig(model=""), tokens="./sherpa-onnx-streaming-
↳ zipformer-en-20M-2023-02-17/tokens.txt", num_threads=1, debug=False, provider="cpu",_
↳ model_type=""), lm_config=OnlineLMConfig(model="", scale=0.5), endpoint_
↳ config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_trailing_
↳ silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_nonsilence=True,_
↳ min_trailing_silence=1.2, min_utterance_length=0), rule3=EndpointRule(must_contain_
↳ nonsilence=False, min_trailing_silence=0, min_utterance_length=20)), enable_
↳ endpoint=True, max_active_paths=4, hotwords_score=1.5, hotwords_file="", decoding_
↳ method="greedy_search", blank_penalty=0)
./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/test_wavs/0.wav
Elapsed seconds: 70, Real time factor (RTF): 11
THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID QUARTER OF THE BRAFFLELS
{ "text": " THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID QUARTER OF THE_
↳ BRAFFLELS", "tokens": [ " THE", " YE", " LL", " OW", " LA", " M", " P", " S", " WOULD", "_
↳ LIGHT", " UP", " HE", " RE", " AND", " THERE", " THE", " S", " QUA", " LI", " D", " ", " QUA
↳ ", " R", " TER", " OF", " THE", " B", " RA", " FF", " L", " EL", " S" ], "timestamps": [ 2.04,
↳ 2.16, 2.28, 2.36, 2.52, 2.64, 2.68, 2.76, 2.92, 3.08, 3.40, 3.60, 3.72, 3.88, 4.12, 4.
↳ 48, 4.64, 4.68, 4.84, 4.96, 5.16, 5.20, 5.32, 5.36, 5.60, 5.72, 5.92, 5.96, 6.08, 6.24,
↳ 6.36, 6.60 ], "ys_probs": [ -0.454799, -0.521409, -0.345871, -0.001244, -0.240359, -0.
↳ 013972, -0.010445, -0.051701, -0.000371, -0.171570, -0.002205, -0.026703, -0.006903, -
↳ 0.021168, -0.011662, -0.001059, -0.005089, -0.000273, -0.575480, -0.024973, -0.159344,
↳ -0.000042, -0.011082, -0.187136, -0.004002, -0.292751, -0.084873, -0.241302, -0.543844,
↳ -0.428164, -0.853198, -0.093776 ], "lm_probs": [ ], "context_scores": [ ], "segment
↳ ": 0, "start_time": 0.0, "is_final": false}
```

---

**Hint:** As you can see, the RTF is 11, indicating that it is very slow to run the model with the qemu simulator. Running on a real RISC-V board should be much faster.

---

## Run text-to-speech with qemu

Please visit <https://github.com/k2-fsa/sherpa-onnx/releases/tag/tts-models> to download a text-to-speech model. We use the following model `vits-piper-en_US-amy-low.tar.bz2`:

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/tts-models/vits-piper-en_US-
amy-low.tar.bz2
tar xf vits-piper-en_US-amy-low.tar.bz2
rm vits-piper-en_US-amy-low.tar.bz2
```

After downloading the model, we can use the following command to run it:

```
cd /path/to/sherpa-onnx

export PATH=$HOME/qemu:$PATH
export QEMU_LD_PREFIX=$HOME/toolchain/sysroot
export LD_LIBRARY_PATH=$HOME/toolchain/sysroot/lib:$LD_LIBRARY_PATH

qemu-riscv64 build-riscv64-linux-gnu/install/bin/sherpa-onnx-offline-tts \
--vits-model=./vits-piper-en_US-amy-low/en_US-amy-low.onnx \
--vits-tokens=./vits-piper-en_US-amy-low/tokens.txt \
--vits-data-dir=./vits-piper-en_US-amy-low/espeak-ng-data \
--output-filename=./a-test.wav \
"Friends fell out often because life was changing so fast. The easiest thing in the
world was to lose touch with someone."
```

The log of the above command is given below:

```
/content/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 build-riscv64-linux-gnu/
install/bin/sherpa-onnx-offline-tts --vits-model=./vits-piper-en_US-amy-low/en_US-amy-
low.onnx --vits-tokens=./vits-piper-en_US-amy-low/tokens.txt --vits-data-dir=./vits-
piper-en_US-amy-low/espeak-ng-data --output-filename=./a-test.wav 'Friends fell out
often because life was changing so fast. The easiest thing in the world was to lose
touch with someone.

Elapsed seconds: 270.745 s
Audio duration: 7.904 s
Real-time factor (RTF): 270.745/7.904 = 34.254
The text is: Friends fell out often because life was changing so fast. The easiest thing
in the world was to lose touch with someone.. Speaker ID: 0
Saved to ./a-test.wav successfully!
```

If you want to build an Android app, please refer to [Android](#). If you want to build an iOS app, please refer to [iOS](#).

## 8.3 Frequently Asked Question (FAQs)

This page contains frequently asked questions for `sherpa-onnx`.

### 8.3.1

,

,

### 8.3.2 Cannot open shared library `libasound_module_conf_pulse.so`

The detailed errors are given below:

```
Cannot open shared library libasound_module_conf_pulse.so
(/usr/lib64/alsa-lib/libasound_module_conf_pulse.so: cannot open shared object file: No
such file or directory)
ALSA lib pcm.c:2722:(snd_pcm_open_noupdate) Unknown PCM
```

If you use Linux and get the above error when trying to use the microphone, please do the following:

1. Locate where is the file `libasound_module_conf_pulse.so` on your system

```
find / -name libasound_module_conf_pulse.so 2>/dev/null
```

2. If the above search command prints:

```
/usr/lib/x86_64-linux-gnu/alsa-lib/libasound_module_conf_pulse.so
/usr/lib/i386-linux-gnu/alsa-lib/libasound_module_conf_pulse.so
```

3. Please run:

```
sudo mkdir -p /usr/lib64/alsa-lib
sudo ln -s /usr/lib/x86_64-linux-gnu/alsa-lib/libasound_module_conf_pulse.
-so /usr/lib64/alsa-lib
```

4. Now your issue should be fixed.

### 8.3.3 TTS

Please see [How to enable UTF-8 on Windows](#). You need to use UTF-8 encoding for your system.

### 8.3.4 ./gitcompile: line 89: libtoolize: command not found

If you are using Linux and get the following error:

```
./gitcompile: line 89: libtoolize: command not found
```

Please run:

```
sudo apt-get install libtool
```

### 8.3.5 OSError: PortAudio library not found

If you have the following error on Linux (Ubuntu),

```
Traceback (most recent call last):
  File "/mnt/sdb/shared/sherpa-onnx./python-api-examples/vad-microphone.py", line 8, in
    <module>
    import sounddevice as sd
  File "/mnt/sdb/shared/py311/lib/python3.11/site-packages/sounddevice.py", line 71, in
    <module>
    raise OSError('PortAudio library not found')
OSError: PortAudio library not found
```

Then please run:

```
sudo apt-get install libportaudio2
```

and then re-try.

### 8.3.6 imports github.com/k2-fsa/sherpa-onnx-go-linux: build constraints exclude all Go files

If you have the following output when running `go build`:

```
[root@VM-0-3-centos non-streaming-decode-files]# go build
package non-streaming-decode-files
  imports github.com/k2-fsa/sherpa-onnx-go/sherpa_onnx
  imports github.com/k2-fsa/sherpa-onnx-go-linux: build constraints exclude all Go files
    in /root/go/pkg/mod/github.com/k2-fsa/sherpa-onnx-go-linux@v1.9.21
```

Please first run:

```
go env -w CGO_ENABLED=1
```

And then re-run `go build`.

## 8.4 Python

In this section, we describe how to install the Python package `sherpa-onnx`.

### 8.4.1 Install the Python Package

You can select one of the following methods to install the Python package.

#### Method 1 (From pre-compiled wheels)

---

**Hint:** This method supports `x86_64`, `arm64` (e.g., Mac M1, 64-bit Raspberry Pi), and `arm32` (e.g., 32-bit Raspberry Pi).

---

```
pip install sherpa-onnx
```

To check you have installed `sherpa-onnx` successfully, please run

```
python3 -c "import sherpa_onnx; print(sherpa_onnx.__file__)"  
which sherpa-onnx  
sherpa-onnx --help  
ls -lh $(dirname $(which sherpa-onnx))/sherpa-onnx*
```

#### Method 2 (From source)

CPU

Nvidia GPU (CUDA)

```
git clone https://github.com/k2-fsa/sherpa-onnx  
cd sherpa-onnx  
python3 setup.py install
```

```
git clone https://github.com/k2-fsa/sherpa-onnx  
export SHERPA_ONNX_CMAKE_ARGS="-DSHERPA_ONNX_ENABLE_GPU=ON"  
cd sherpa-onnx  
python3 setup.py install
```

### Method 3 (For developers)

CPU

Nvidia GPU (CUDA)

```
git clone https://github.com/k2-fsa/sherpa-onnx
cd sherpa-onnx
mkdir build
cd build

cmake \
-DSHERPA_ONNX_ENABLE_PYTHON=ON \
-DBUILD_SHARED_LIBS=ON \
-DSHERPA_ONNX_ENABLE_CHECK=OFF \
-DSHERPA_ONNX_ENABLE_PORTAUDIO=OFF \
-DSHERPA_ONNX_ENABLE_C_API=OFF \
-DSHERPA_ONNX_ENABLE_WEBSOCKET=OFF \
..

make -j
export PYTHONPATH=$PWD/..sherpa-onnx/python/:$PWD/lib:$PYTHONPATH
```

```
git clone https://github.com/k2-fsa/sherpa-onnx
cd sherpa-onnx
mkdir build
cd build

cmake \
-DSHERPA_ONNX_ENABLE_PYTHON=ON \
-DBUILD_SHARED_LIBS=ON \
-DSHERPA_ONNX_ENABLE_CHECK=OFF \
-DSHERPA_ONNX_ENABLE_PORTAUDIO=OFF \
-DSHERPA_ONNX_ENABLE_C_API=OFF \
-DSHERPA_ONNX_ENABLE_WEBSOCKET=OFF \
-DSHERPA_ONNX_ENABLE_GPU=ON \
..

make -j
export PYTHONPATH=$PWD/..sherpa-onnx/python/:$PWD/lib:$PYTHONPATH
```

**Hint:** You need to install CUDA toolkit. Otherwise, you would get errors at runtime.

You can refer to <https://k2-fsa.github.io/k2/installation/cuda-cudnn.html> to install CUDA toolkit.

## Check your installation

To check that `sherpa-onnx` has been successfully installed, please use:

```
python3 -c "import sherpa_onnx; print(sherpa_onnx.__file__)"
```

It should print some output like below:

```
/Users/fangjun/py38/lib/python3.8/site-packages/sherpa_onnx/__init__.py
```

Please refer to:

<https://github.com/k2-fsa/sherpa-onnx/tree/master/python-api-examples>

for usages.

Please refer to *Pre-trained models* for a list of pre-trained models.

### 8.4.2 Decode files

In this section, we demonstrate how to use the Python API of `sherpa-onnx` to decode files.

---

**Hint:** We only support WAVE files of single channel and each sample should have 16-bit, while the sample rate of the file can be arbitrary and it does not need to be 16 kHz

---

#### Streaming zipformer

We use `csukuangfj/sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20` (*Bilingual, Chinese + English*) as an example below.

```
cd /path/to/sherpa-onnx

python3 ./python-api-examples/online-decode-files.py \
--tokens=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/tokens.txt \
--encoder=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/encoder-epoch-99-avg-1.onnx \
--decoder=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/joiner-epoch-99-avg-1.onnx \
./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/test_wavs/0.wav \
./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/test_wavs/1.wav \
./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/test_wavs/2.wav \
./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/test_wavs/3.wav \
./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/test_wavs/8k.wav
```

---

**Hint:** `online-decode-files.py` is from <https://github.com/k2-fsa/sherpa-onnx/blob/master/python-api-examples/online-decode-files.py>

---

---

**Note:** You can replace `encoder-epoch-99-avg-1.onnx` with `encoder-epoch-99-avg-1.int8.onnx` to use `int8` models for decoding.

---

The output is given below:

```
Creating a resampler:
  in_sample_rate: 8000
  output_sample_rate: 16000

Started!
Done!
./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/test_wavs/0.wav
MONDAY TODAY IS LIBR THE DAY AFTER TOMORROW
-----
./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/test_wavs/1.wav
ALWAYS ALWAYS
-----
./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/test_wavs/2.wav
FREQUENTLY
-----
./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/test_wavs/3.wav
ES
-----
./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/test_wavs/8k.wav
IN TIME
-----
num_threads: 1
decoding_method: greedy_search
Wave duration: 17.640 s
Elapsed time: 3.907 s
Real time factor (RTF): 3.907/17.640 = 0.221
```

## Non-streaming zipformer

We use [csukuangfj/sherpa-onnx-zipformer-en-2023-04-01 \(English\)](https://github.com/csukuangfj/sherpa-onnx-zipformer-en-2023-04-01) as an example below.

```
cd /path/to/sherpa-onnx

python3 ./python-api-examples/offline-decode-files.py \
  --tokens=./sherpa-onnx-zipformer-en-2023-04-01/tokens.txt \
  --encoder=./sherpa-onnx-zipformer-en-2023-04-01/encoder-epoch-99-avg-1.onnx \
  --decoder=./sherpa-onnx-zipformer-en-2023-04-01/decoder-epoch-99-avg-1.onnx \
  --joiner=./sherpa-onnx-zipformer-en-2023-04-01/joiner-epoch-99-avg-1.onnx \
  ./sherpa-onnx-zipformer-en-2023-04-01/test_wavs/0.wav \
  ./sherpa-onnx-zipformer-en-2023-04-01/test_wavs/1.wav \
  ./sherpa-onnx-zipformer-en-2023-04-01/test_wavs/8k.wav
```

---

**Hint:** `offline-decode-files.py` is from <https://github.com/k2-fsa/sherpa-onnx/blob/master/python-api-examples/offline-decode-files.py>

---

---

**Note:** You can replace `encoder-epoch-99-avg-1.onnx` with `encoder-epoch-99-avg-1.int8.onnx` to use `int8` models for decoding.

---

The output is given below:

```
Creating a resampler:  
  in_sample_rate: 8000  
  output_sample_rate: 16000  
  
Started!  
Done!  
.sherpa-onnx-zipformer-en-2023-04-01/test_wavs/0.wav  
AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID  
→ QUARTER OF THE BROTHELS  
-----  
.sherpa-onnx-zipformer-en-2023-04-01/test_wavs/1.wav  
GOD AS A DIRECT CONSEQUENCE OF THE SIN WHICH MAN THUS PUNISHED HAD GIVEN HER A LOVELY  
→ CHILD WHOSE PLACE WAS ON THAT SAME DISHONORED BOSOM TO CONNECT HER PARENT FOR EVER  
→ WITH THE RACE AND DESCENT OF MORTALS AND TO BE FINALLY A BLESSED SOUL IN HEAVEN  
-----  
.sherpa-onnx-zipformer-en-2023-04-01/test_wavs/8k.wav  
YET THESE THOUGHTS AFFECTED HESTER PRYNNE LESS WITH HOPE THAN APPREHENSION  
-----  
num_threads: 1  
decoding_method: greedy_search  
Wave duration: 4.825 s  
Elapsed time: 2.567 s  
Real time factor (RTF): 2.567/4.825 = 0.532
```

## Non-streaming paraformer

We use [csukuangfj/sherpa-onnx-paraformer-zh-2023-03-28](https://github.com/csukuangfj/sherpa-onnx-paraformer-zh-2023-03-28) (*Chinese + English*) as an example below.

```
cd /path/to/sherpa-onnx  
  
python3 ./python-api-examples/offline-decode-files.py \  
--tokens=./sherpa-onnx-paraformer-zh-2023-03-28/tokens.txt \  
--paraformer=./sherpa-onnx-paraformer-zh-2023-03-28/model.onnx \  
.sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/0.wav \  
.sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/1.wav \  
.sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/2.wav \  
.sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/8k.wav
```

---

**Note:** You can replace `model.onnx` with `model.int8.onnx` to use `int8` models for decoding.

---

The output is given below:

```
Creating a resampler:  
  in_sample_rate: 8000  
  output_sample_rate: 16000
```

(continues on next page)

(continued from previous page)

```

Started!
Done!
./sherpa-onnx-parafomer-zh-2023-03-28/test_wavs/0.wav
-----
./sherpa-onnx-parafomer-zh-2023-03-28/test_wavs/1.wav
-----
./sherpa-onnx-parafomer-zh-2023-03-28/test_wavs/2.wav
-----
./sherpa-onnx-parafomer-zh-2023-03-28/test_wavs/8k.wav
-----
num_threads: 1
decoding_method: greedy_search
Wave duration: 4.204 s
Elapsed time: 1.663 s
Real time factor (RTF): 1.663/4.204 = 0.396

```

### 8.4.3 Real-time speech recognition from a microphone

In this section, we demonstrate how to use the Python API of `sherpa-onnx` for real-time speech recognition with a microphone.

#### With endpoint detection

```

cd /path/to/sherpa-onnx

python3 ./python-api-examples/speech-recognition-from-microphone-with-endpoint-detection.
  ↵py \
    --tokens=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/tokens.txt \
    --encoder=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/encoder-epoch-
  ↵99-avg-1.onnx \
    --decoder=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/decoder-epoch-
  ↵99-avg-1.onnx \
    --joiner=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/joiner-epoch-99-
  ↵avg-1.onnx

```

**Hint:** `speech-recognition-from-microphone-with-endpoint-detection.py` is from <https://github.com/k2-fsa/sherpa-onnx/blob/master/python-api-examples/speech-recognition-from-microphone-with-endpoint-detection.py>

In the above demo, the model files are from <https://github.com/csukuangfj/sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20> (*Bilingual, Chinese + English*).

### Without endpoint detection

```
cd /path/to/sherpa-onnx

python3 ./python-api-examples/speech-recognition-from-microphone.py \
--tokens=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/tokens.txt \
--encoder=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/encoder-epoch- \
→ 99-avg-1.onnx \
--decoder=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/decoder-epoch- \
→ 99-avg-1.onnx \
--joiner=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/joiner-epoch-99- \
→ avg-1.onnx
```

---

**Hint:** `speech-recognition-from-microphone.py` is from <https://github.com/k2-fsa/sherpa-onnx/blob/master/python-api-examples/speech-recognition-from-microphone.py>

In the above demo, the model files are from [csukuangfj/sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20](https://github.com/csukuangfj/sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20) (*Bilingual, Chinese + English*).

---

#### 8.4.4 Speech recognition from URLs

`sherpa-onnx` also supports decoding from URLs.

---

**Hint:** Only streaming models are currently supported. Please modify the code for non-streaming models on need.

---

All types of URLs supported by `ffmpeg` are supported.

The following table lists some example URLs.

Type	Example
RTMP	<code>rtmp://localhost/live/livestream</code>
OPUS file	<code>https://huggingface.co/spaces/k2-fsa/automatic-speech-recognition/resolve/main/test_wavs/wenetspeech/DEV_T0000000000.opus</code>
WAVE file	<code>https://huggingface.co/spaces/k2-fsa/automatic-speech-recognition/resolve/main/test_wavs/aishell2/ID0012W0030.wav</code>
Local WAVE file	<code>file:///Users/fangjun/open-source/sherpa-onnx/a.wav</code>

Before you continue, please install `ffmpeg` first.

For instance, you can use `sudo apt-get install ffmpeg` for Ubuntu and `brew install ffmpeg` for macOS.

We use the model [csukuangfj/sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20](https://github.com/csukuangfj/sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20) (*Bilingual, Chinese + English*) for demonstration in the following examples.

## Decode a URL

This example shows you how to decode a URL pointing to a file.

---

**Hint:** The file does not need to be a WAVE file. It can be a file of any format supported by `ffmpeg`.

---

```
python3 ./python-api-examples/speech-recognition-from-url.py \
--encoder ./sherpa-onnx-streaming-zipformer-en-2023-06-26/encoder-epoch-99-avg-1-chunk-
˓→16-left-128.onnx \
--decoder ./sherpa-onnx-streaming-zipformer-en-2023-06-26/decoder-epoch-99-avg-1-chunk-
˓→16-left-128.onnx \
--joiner ./sherpa-onnx-streaming-zipformer-en-2023-06-26/joiner-epoch-99-avg-1-chunk-
˓→16-left-128.onnx \
--tokens ./sherpa-onnx-streaming-zipformer-en-2023-06-26/tokens.txt \
--url https://huggingface.co/spaces/k2-fsa/automatic-speech-recognition/resolve/main/
˓→test_wavs/librispeech/1089-134686-0001.wav
```

## RTMP

In this example, we use `ffmpeg` to capture a microphone and push the audio stream to a server using RTMP, and then we start `sherpa-onnx` to pull the audio stream from the server for recognition.

### Install the server

We will use `srs` as the server. Let us first install `srs` from source:

```
git clone -b develop https://github.com/ossrs/srs.git
cd srs/trunk
./configure
make

# Check that we have compiled srs successfully
./objs/srs --help

# Note: ./objs/srs is statically linked and depends only on system libraries.
```

### Start the server

```
ulimit -HSn 10000

# switch to the directory srs/trunk
./objs/srs -c conf/srs.conf
```

The above command gives the following output:

```
srs(51047,0x7ff8451198c0) malloc: nano zone abandoned due to inability to preallocate
˓→reserved vm space.
Asan: Please setup the env MallocNanoZone=0 to disable the warning, see https://
˓→stackoverflow.com/a/70209891/17679565
```

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```
[2023-07-05 12:19:23.017] [INFO] [51047] [78gw8v44] XCORE-SRS/6.0.55(Bee)
[2023-07-05 12:19:23.021] [INFO] [51047] [78gw8v44] config parse complete
[2023-07-05 12:19:23.021] [INFO] [51047] [78gw8v44] you can check log by: tail -n 30 -f ./objs/srs.log
[2023-07-05 12:19:23.021] [INFO] [51047] [78gw8v44] please check SRS by: ./etc/init.d/srs status
```

To check the status of `srs`, use

```
./etc/init.d/srs status
```

which gives the following output:

```
SRS(pid 51548) is running. [ OK ]
```

---

**Hint:** If you fail to start the `srs` server, please check the log file `./objs/srs.log` for a fix.

---

## Start `ffmpeg` to push audio stream

First, let us list available recording devices on the current computer with the following command:

```
ffmpeg -hide_banner -f avfoundation -list_devices true -i ""
```

It gives the following output on my computer:

```
[AVFoundation indev @ 0x7f9f41904840] AVFoundation video devices:
[AVFoundation indev @ 0x7f9f41904840] [0] FaceTime HD Camera (Built-in)
[AVFoundation indev @ 0x7f9f41904840] [1] Capture screen 0
[AVFoundation indev @ 0x7f9f41904840] AVFoundation audio devices:
[AVFoundation indev @ 0x7f9f41904840] [0] Background Music
[AVFoundation indev @ 0x7f9f41904840] [1] MacBook Pro Microphone
[AVFoundation indev @ 0x7f9f41904840] [2] Background Music (UI Sounds)
[AVFoundation indev @ 0x7f9f41904840] [3] WeMeet Audio Device
: Input/output error
```

We will use the device [1] `MacBook Pro Microphone`. Note that its index is 1, so we will use `-i ":1"` in the following command to start recording and push the recorded audio stream to the server under the address `rtmp://localhost/live/livestream`.

---

**Hint:** The default TCP port for `RTMP` is 1935.

---

```
ffmpeg -hide_banner -f avfoundation -i ":1" -acodec aac -ab 64k -ar 16000 -ac 1 -f flv -rtmp://localhost/live/livestream
```

The above command gives the following output:

```
Input #0, avfoundation, from ':1':
  Duration: N/A, start: 830938.803938, bitrate: 1536 kb/s
    Stream #0:0: Audio: pcm_f32le, 48000 Hz, mono, flt, 1536 kb/s
```

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```

Stream mapping:
Stream #0:0 -> #0:0 (pcm_f32le (native) -> aac (native))
Press [q] to stop, [?] for help
Output #0, flv, to 'rtmp://localhost/live/livestream':
  Metadata:
    encoder      : Lavf60.3.100
  Stream #0:0: Audio: aac (LC) ([10][0][0][0] / 0x000A), 16000 Hz, mono, fltp, 64 kb/s
    Metadata:
      encoder      : Lavc60.3.100 aac
size=   64kB time=00:00:08.39 bitrate= 62.3kbit/s speed=0.977x

```

### Start sherpa-onnx to pull audio stream

Now we can start `sherpa-onnx` to pull audio stream from `rtmp://localhost/live/livestream` for speech recognition.

```

python3 ./python-api-examples/speech-recognition-from-url.py \
--encoder ./sherpa-onnx-streaming-zipformer-en-2023-06-26/encoder-epoch-99-avg-1-chunk-
˓→16-left-128.onnx \
--decoder ./sherpa-onnx-streaming-zipformer-en-2023-06-26/decoder-epoch-99-avg-1-chunk-
˓→16-left-128.onnx \
--joiner ./sherpa-onnx-streaming-zipformer-en-2023-06-26/joiner-epoch-99-avg-1-chunk-
˓→16-left-128.onnx \
--tokens ./sherpa-onnx-streaming-zipformer-en-2023-06-26/tokens.txt \
--url rtmp://localhost/live/livestream

```

You should see the recognition result printed to the console as you speak.

---

**Hint:** You can replace `localhost` with your server IP and start `sherpa-onnx` on many computers at the same time to pull audio stream from the address `rtmp://your_server_ip/live/livestream`.

---

### 8.4.5 Streaming WebSocket Server

This section describes how to use the Python streaming WebSocket server of `sherpa-onnx` for speech recognition.

---

**Hint:** The server supports multiple clients connecting at the same time.

---

The code for the streaming server can be found at

[https://github.com/k2-fsa/sherpa-onnx/blob/master/python-api-examples/streaming\\_server.py](https://github.com/k2-fsa/sherpa-onnx/blob/master/python-api-examples/streaming_server.py)

## Start the server

---

### Hint:

If you don't use a [X.509](#) certificate, due to security reasons imposed by the browser, you are only allowed to use the domain `localhost` to access the server if you want to access the microphone in the browser. That is, you can only use

```
http://localhost:port
```

to access the server. You cannot use `http://0.0.0.0:port`, or `http://127.0.0.1:port`, or `http://public_ip:port`.

You can use the following command to generate a self-signed certificate:

```
cd python-api-examples/web  
./generate-certificate.py
```

The above commands will generate 3 files. You only need to use the file `cert.pem`. When starting the server, you pass the following argument:

```
--certificate=./python-api-examples/web/cert.pem
```

---

Please refer to [Pre-trained models](#) to download a streaming model before you continue.

We will use [csukuangfj/sherpa-onnx-streaming-zipformer-en-2023-06-26 \(English\)](#) as an example.

First, let us download it:

```
cd /path/to/sherpa-onnx/  
  
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-  
streaming-zipformer-en-2023-06-26.tar.bz2  
tar xvf sherpa-onnx-streaming-zipformer-en-2023-06-26.tar.bz2  
rm sherpa-onnx-streaming-zipformer-en-2023-06-26.tar.bz2
```

Now we can use:

```
cd /path/to/sherpa-onnx/  
  
python3 ./python-api-examples/streaming_server.py \  
--encoder ./sherpa-onnx-streaming-zipformer-en-2023-06-26/encoder-epoch-99-avg-1-chunk-  
16-left-128.onnx \  
--decoder ./sherpa-onnx-streaming-zipformer-en-2023-06-26/decoder-epoch-99-avg-1-chunk-  
16-left-128.onnx \  
--joiner ./sherpa-onnx-streaming-zipformer-en-2023-06-26/joiner-epoch-99-avg-1-chunk-  
16-left-128.onnx \  
--tokens ./sherpa-onnx-streaming-zipformer-en-2023-06-26/tokens.txt \  
--port 6006
```

It will print the following logs:

```
2023-08-11 16:29:51,522 INFO [streaming_server.py:678] {'encoder': './sherpa-onnx-  
streaming-zipformer-en-2023-06-26/encoder-epoch-99-avg-1-chunk-16-left-128.onnx',  
'decoder': './sherpa-onnx-streaming-zipformer-en-2023-06-26/decoder-epoch-99-avg-1-  
chunk-16-left-128.onnx', 'joiner': './sherpa-onnx-streaming-zipformer-en-2023-06-26/  
joiner-epoch-99-avg-1-chunk-16-left-128.onnx', 'tokens': './sherpa-onnx-streaming-  
zipformer-en-2023-06-26/tokens.txt', 'sample_rate': 16000, 'feat_dim': 80, 'provider':  
'cpu', 'decoding_method': 'greedy_search', 'num_active_paths': 4, 'use_endpoint': 1,  
'rule1_min_trailing_silence': 2.4, 'rule2_min_trailing_silence': 1.8, 'rule3_min_utterance_length': 20, 'port': 6006, 'nn_pool_size': 1, 'max_batch_size': 50, 'max_wait_ms': 10, 'max_message_size': 1048576, 'max_queue_size': 32, 'max_active_connections': 500, 'num_threads': 2, 'certificate': None, 'doc_root': './python-api-examples/web'}
```

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```
2023-08-11 16:29:57,476 INFO [streaming_server.py:520] No certificate provided
2023-08-11 16:29:57,480 INFO [server.py:707] server listening on 0.0.0.0:6006
2023-08-11 16:29:57,480 INFO [server.py:707] server listening on [::]:6006
2023-08-11 16:29:57,480 INFO [streaming_server.py:546] Please visit one of the following ↵
  ↵ addresses:
```

<http://localhost:6006>

Since you are not providing a certificate, you cannot use your microphone from within ↵  
 ↵ the browser using public IP addresses. Only localhost can be used. You also cannot use ↵  
 ↵ 0.0.0.0 or 127.0.0.1

We can use the following two methods to interact with the server:

- Use Python API
- Use a browser by accessing <http://localhost:6006>

We describe each method below in details.

## Use Python API

We provide two Python example files:

Description	URL
Send a file for decoding	<a href="https://github.com/k2-fsa/sherpa-onnx/blob/master/python-api-examples/online-websocket-client-decode-file.py">https://github.com/k2-fsa/sherpa-onnx/blob/master/python-api-examples/online-websocket-client-decode-file.py</a>
Send audio samples from a microphone for decoding	<a href="https://github.com/k2-fsa/sherpa-onnx/blob/master/python-api-examples/speech-recognition-from-microphone.py">https://github.com/k2-fsa/sherpa-onnx/blob/master/python-api-examples/speech-recognition-from-microphone.py</a>

### Send a file for decoding

**Hint:** The example file supports only \*.wav files with a single channel and the each sample should be of type `int16_t`. The sample rate does not need to be 16000 Hz, e.g., it can be 48000 Hz, 8000 Hz or some other value.

We use the following command to send a file for decoding:

```
cd /path/to/sherpa-onnx
python3 ./python-api-examples/online-websocket-client-decode-file.py \
  --server-addr localhost \
  --server-port 6006 \
  ./sherpa-onnx-streaming-zipformer-en-2023-06-26/test_wavs/0.wav
```

It should give the following output:

```
2023-08-11 16:37:03,877 INFO [online-websocket-client-decode-file.py:133] Sending ./sherpa-onnx-streaming-zipformer-en-2023-06-26/test_wavs/0.wav
2023-08-11 16:37:03,931 INFO [online-websocket-client-decode-file.py:115] {"text": "", "segment": 0}
```

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```

2023-08-11 16:37:04,012 INFO [online-websocket-client-decode-file.py:115] {"text": "",  
→ "segment": 0}  

2023-08-11 16:37:04,128 INFO [online-websocket-client-decode-file.py:115] {"text": "AFTER  
→", "segment": 0}  

2023-08-11 16:37:04,170 INFO [online-websocket-client-decode-file.py:115] {"text":  
→ "AFTER EARLY", "segment": 0}  

2023-08-11 16:37:04,228 INFO [online-websocket-client-decode-file.py:115] {"text":  
→ "AFTER EARLY", "segment": 0}  

2023-08-11 16:37:04,331 INFO [online-websocket-client-decode-file.py:115] {"text":  
→ "AFTER EARLY NIGHTFA", "segment": 0}  

2023-08-11 16:37:04,373 INFO [online-websocket-client-decode-file.py:115] {"text":  
→ "AFTER EARLY NIGHTFALL THE", "segment": 0}  

2023-08-11 16:37:04,433 INFO [online-websocket-client-decode-file.py:115] {"text":  
→ "AFTER EARLY NIGHTFALL THE YELLOW LA", "segment": 0}  

2023-08-11 16:37:04,535 INFO [online-websocket-client-decode-file.py:115] {"text":  
→ "AFTER EARLY NIGHTFALL THE YELLOW LAMPS", "segment": 0}  

2023-08-11 16:37:04,576 INFO [online-websocket-client-decode-file.py:115] {"text":  
→ "AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT", "segment": 0}  

2023-08-11 16:37:04,645 INFO [online-websocket-client-decode-file.py:115] {"text":  
→ "AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP", "segment": 0}  

2023-08-11 16:37:04,685 INFO [online-websocket-client-decode-file.py:115] {"text":  
→ "AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE", "segment": 0}  

2023-08-11 16:37:04,755 INFO [online-websocket-client-decode-file.py:115] {"text":  
→ "AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE", "segment": 0}  

2023-08-11 16:37:04,847 INFO [online-websocket-client-decode-file.py:115] {"text":  
→ "AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE", "segment": 0}  

2023-08-11 16:37:04,887 INFO [online-websocket-client-decode-file.py:115] {"text":  
→ "AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUA",  
→ "segment": 0}  

2023-08-11 16:37:04,958 INFO [online-websocket-client-decode-file.py:115] {"text":  
→ "AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID",  
→ "segment": 0}  

2023-08-11 16:37:05,057 INFO [online-websocket-client-decode-file.py:115] {"text":  
→ "AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID QUAR  
→", "segment": 0}  

2023-08-11 16:37:05,095 INFO [online-websocket-client-decode-file.py:115] {"text":  
→ "AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID QUAR  
→ QUARTER OF", "segment": 0}  

2023-08-11 16:37:05,164 INFO [online-websocket-client-decode-file.py:115] {"text":  
→ "AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID QUAR  
→ QUARTER OF THE BRO", "segment": 0}  

2023-08-11 16:37:05,268 INFO [online-websocket-client-decode-file.py:115] {"text":  
→ "AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID QUAR  
→ QUARTER OF THE BROTHEL", "segment": 0}  

2023-08-11 16:37:05,369 INFO [online-websocket-client-decode-file.py:115] {"text":  
→ "AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID QUAR  
→ QUARTER OF THE BROTHELS", "segment": 0}  

2023-08-11 16:37:05,370 INFO [online-websocket-client-decode-file.py:154]  

Final result is:  

{"text": "AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE  
→ SQUALID QUARTER OF THE BROTHELS", "segment": 0}

```

## Send audio samples from a microphone for decoding

We use the following command to run the script:

```
cd /path/to/sherpa-onnx
python3 ./python-api-examples/online-websocket-client-microphone.py \
--server-addr localhost \
--server-port 6006
```

It should give you the following output:

```
{'server_addr': 'localhost', 'server_port': 6006}
Started! Please Speak
  0 Background Music, Core Audio (2 in, 2 out)
  1 Background Music (UI Sounds), Core Audio (2 in, 2 out)
> 2 MacBook Pro Microphone, Core Audio (1 in, 0 out)
< 3 MacBook Pro Speakers, Core Audio (0 in, 2 out)
  4 WeMeet Audio Device, Core Audio (2 in, 2 out)
Use default device: MacBook Pro Microphone

Started! Please speak
```

If you speak, you will see the recognition result returned by the server.

## Use a browser

Start your browser and visit the following address:

<http://localhost:6006/>

You should see a page like below:

← → ⌂ ⌂ localhost:6006

Next-gen Kaldi demo   Home   Upload   Streaming-Record   Offline-Record

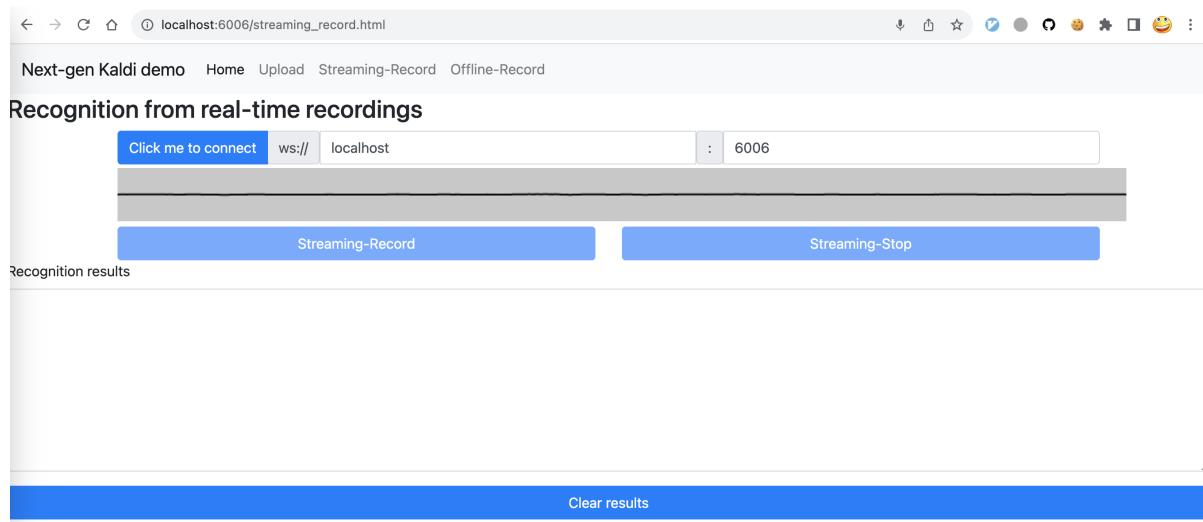
**Upload**  
Recognition from a selected file

**Streaming\_Record**  
Recognition from real-time recordings

**Offline\_Record**  
Recognition from offline recordings

Code is available at <https://github.com/k2-fsa/sherpa-onnx>

Click **Streaming-Record** and you will see the following page:



Click the button `Click me to connect` to connect to the server and then you can click the `Streaming-Record` button to start recording. You should see the decoded results as you speak.

## colab

We provide a colab notebook for you to try the Python streaming websocket server example of `sherpa-onnx`.

### 8.4.6 Non-Streaming WebSocket Server

This section describes how to use the Python non-streaming WebSocket server of `sherpa-onnx` for speech recognition.

---

**Hint:** The server supports multiple clients connecting at the same time.

---

The code for the non-streaming server can be found at

[https://github.com/k2-fsa/sherpa-onnx/blob/master/python-api-examples/non\\_streaming\\_server.py](https://github.com/k2-fsa/sherpa-onnx/blob/master/python-api-examples/non_streaming_server.py)

Please refer to *Pre-trained models* to download a non-streaming model before you continue.

We use the following types of models for demonstration.

Description	URL
Non-streaming transducer	<a href="https://huggingface.co/csukuangfj/sherpa-onnx-zipformer-en-2023-06-26">csukuangfj/sherpa-onnx-zipformer-en-2023-06-26 (English)</a>
Non-streaming paraformer	<a href="https://huggingface.co/csukuangfj/sherpa-onnx-paraformer-zh-2023-03-28">csukuangfj/sherpa-onnx-paraformer-zh-2023-03-28 (Chinese + English)</a>
Non-streaming CTC model from NeMo	<a href="https://huggingface.co/stt_en_conformer_ctc_medium">stt_en_conformer_ctc_medium</a>
Non-streaming Whisper tiny.en	<a href="https://huggingface.co/tiny.en">tiny.en</a>

## Non-streaming transducer

### Start the server

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
zipformer-en-2023-06-26.tar.bz2
tar xvf sherpa-onnx-zipformer-en-2023-06-26.tar.bz2
rm sherpa-onnx-zipformer-en-2023-06-26.tar.bz2

python3 ./python-api-examples/non_streaming_server.py \
--encoder ./sherpa-onnx-zipformer-en-2023-06-26/encoder-epoch-99-avg-1.onnx \
--decoder ./sherpa-onnx-zipformer-en-2023-06-26/decoder-epoch-99-avg-1.onnx \
--joiner ./sherpa-onnx-zipformer-en-2023-06-26/joiner-epoch-99-avg-1.onnx \
--tokens ./sherpa-onnx-zipformer-en-2023-06-26/tokens.txt \
--port 6006
```

### Start the client

#### Decode multiple files in parallel

```
python3 ./python-api-examples/offline-websocket-client-decode-files-paralell.py \
--server-addr localhost \
--server-port 6006 \
./sherpa-onnx-zipformer-en-2023-06-26/test_wavs/0.wav \
./sherpa-onnx-zipformer-en-2023-06-26/test_wavs/1.wav \
./sherpa-onnx-zipformer-en-2023-06-26/test_wavs/8k.wav
```

You should see the following output:

```
2023-08-11 18:19:26,000 INFO [offline-websocket-client-decode-files-paralell.py:139] {
  ↵ 'server_addr': 'localhost', 'server_port': 6006, 'sound_files': ['./sherpa-onnx-
  ↵ zipformer-en-2023-06-26/test_wavs/0.wav', './sherpa-onnx-zipformer-en-2023-06-26/test_-
  ↵ wavs/1.wav', './sherpa-onnx-zipformer-en-2023-06-26/test_wavs/8k.wav']}
2023-08-11 18:19:26,034 INFO [offline-websocket-client-decode-files-paralell.py:113] ↵
  ↵ Sending ./sherpa-onnx-zipformer-en-2023-06-26/test_wavs/8k.wav
2023-08-11 18:19:26,058 INFO [offline-websocket-client-decode-files-paralell.py:113] ↵
  ↵ Sending ./sherpa-onnx-zipformer-en-2023-06-26/test_wavs/1.wav
2023-08-11 18:19:26,205 INFO [offline-websocket-client-decode-files-paralell.py:113] ↵
  ↵ Sending ./sherpa-onnx-zipformer-en-2023-06-26/test_wavs/0.wav
2023-08-11 18:19:26,262 INFO [offline-websocket-client-decode-files-paralell.py:131] ./
  ↵ sherpa-onnx-zipformer-en-2023-06-26/test_wavs/8k.wav
  YET THESE THOUGHTS AFFECTED HESTER PRYNNE LESS WITH HOPE THAN APPREHENSION
2023-08-11 18:19:26,609 INFO [offline-websocket-client-decode-files-paralell.py:131] ./
  ↵ sherpa-onnx-zipformer-en-2023-06-26/test_wavs/1.wav
  GOD AS A DIRECT CONSEQUENCE OF THE SIN WHICH MAN THUS PUNISHED HAD GIVEN HER A LOVELY. ↵
  ↵ CHILD WHOSE PLACE WAS ON THAT SAME DISHONORED BOSOM TO CONNECT HER PARENT FOREVER WITH. ↵
  ↵ THE RACE AND DESCENT OF MORTALS AND TO BE FINALLY A BLESSED SOUL IN HEAVEN
2023-08-11 18:19:26,773 INFO [offline-websocket-client-decode-files-paralell.py:131] ./
  ↵ sherpa-onnx-zipformer-en-2023-06-26/test_wavs/0.wav
  AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID. ↵
  ↵ QUARTER OF THE BROTHELS
```

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**Decode multiple files sequentially**

```
python3 ./python-api-examples/offline-websocket-client-decode-files-sequential.py \
--server-addr localhost \
--server-port 6006 \
./sherpa-onnx-zipformer-en-2023-06-26/test_wavs/0.wav \
./sherpa-onnx-zipformer-en-2023-06-26/test_wavs/1.wav \
./sherpa-onnx-zipformer-en-2023-06-26/test_wavs/8k.wav
```

You should see the following output:

```
2023-08-11 18:20:36,677 INFO [offline-websocket-client-decode-files-sequential.py:114] ↵
↳ Sending ./sherpa-onnx-zipformer-en-2023-06-26/test_wavs/0.wav
AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID ↵
↳ QUARTER OF THE BROTHELS
2023-08-11 18:20:36,861 INFO [offline-websocket-client-decode-files-sequential.py:114] ↵
↳ Sending ./sherpa-onnx-zipformer-en-2023-06-26/test_wavs/1.wav
GOD AS A DIRECT CONSEQUENCE OF THE SIN WHICH MAN THUS PUNISHED HAD GIVEN HER A LOVELY ↵
↳ CHILD WHOSE PLACE WAS ON THAT SAME DISHONORED BOSOM TO CONNECT HER PARENT FOREVER WITH ↵
↳ THE RACE AND DESCENT OF MORTALS AND TO BE FINALLY A BLESSED SOUL IN HEAVEN
2023-08-11 18:20:37,375 INFO [offline-websocket-client-decode-files-sequential.py:114] ↵
↳ Sending ./sherpa-onnx-zipformer-en-2023-06-26/test_wavs/8k.wav
YET THESE THOUGHTS AFFECTION HESTER PRYNNE LESS WITH HOPE THAN APPREHENSION
```

**Non-streaming paraformer****Start the server**

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
↳ paraformer-zh-2023-03-28.tar.bz2
tar xvf sherpa-onnx-paraformer-zh-2023-03-28.tar.bz2
rm sherpa-onnx-paraformer-zh-2023-03-28.tar.bz2

python3 ./python-api-examples/non_streaming_server.py \
--paraformer ./sherpa-onnx-paraformer-zh-2023-03-28/model.int8.onnx \
--tokens ./sherpa-onnx-paraformer-zh-2023-03-28/tokens.txt \
--port 6006
```

## Start the client

### Decode multiple files in parallel

```
python3 ./python-api-examples/offline-websocket-client-decode-files-paralell.py \
--server-addr localhost \
--server-port 6006 \
./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/0.wav \
./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/1.wav \
./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/2.wav \
./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/8k.wav
```

You should see the following output:

```
2023-08-11 18:22:54,189 INFO [offline-websocket-client-decode-files-paralell.py:113] \
↳ Sending ./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/0.wav
2023-08-11 18:22:54,233 INFO [offline-websocket-client-decode-files-paralell.py:113] \
↳ Sending ./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/1.wav
2023-08-11 18:22:54,275 INFO [offline-websocket-client-decode-files-paralell.py:113] \
↳ Sending ./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/8k.wav
2023-08-11 18:22:54,295 INFO [offline-websocket-client-decode-files-paralell.py:113] \
↳ Sending ./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/2.wav
2023-08-11 18:22:54,380 INFO [offline-websocket-client-decode-files-paralell.py:131] ./
↳ sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/0.wav

2023-08-11 18:22:54,673 INFO [offline-websocket-client-decode-files-paralell.py:131] ./
↳ sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/8k.wav

2023-08-11 18:22:54,673 INFO [offline-websocket-client-decode-files-paralell.py:131] ./
↳ sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/2.wav

2023-08-11 18:22:54,674 INFO [offline-websocket-client-decode-files-paralell.py:131] ./
↳ sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/1.wav
```

### Decode multiple files sequentially

```
python3 ./python-api-examples/offline-websocket-client-decode-files-sequential.py \
--server-addr localhost \
--server-port 6006 \
./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/0.wav \
./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/1.wav \
./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/2.wav \
./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/8k.wav
```

You should see the following output:

```
2023-08-11 18:24:32,678 INFO [offline-websocket-client-decode-files-sequential.py:141] { \
↳ 'server_addr': 'localhost', 'server_port': 6006, 'sound_files': ['./sherpa-onnx- \
↳ paraformer-zh-2023-03-28/test_wavs/0.wav', './sherpa-onnx-paraformer-zh-2023-03-28/ \
↳ test_wavs/1.wav', './sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/2.wav', './sherpa- \
↳ onnx-paraformer-zh-2023-03-28/test_wavs/8k.wav']}
2023-08-11 18:24:32,709 INFO [offline-websocket-client-decode-files-sequential.py:114] \
↳ Sending ./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/0.wav
```

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```
2023-08-11 18:24:32,883 INFO [offline-websocket-client-decode-files-sequential.py:114] ↵
↳ Sending ./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/1.wav

2023-08-11 18:24:33,042 INFO [offline-websocket-client-decode-files-sequential.py:114] ↵
↳ Sending ./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/2.wav

2023-08-11 18:24:33,175 INFO [offline-websocket-client-decode-files-sequential.py:114] ↵
↳ Sending ./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/8k.wav
```

## Non-streaming CTC model from NeMo

### Start the server

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-nemo-
↳ ctc-en-conformer-medium.tar.bz2
tar xvf sherpa-onnx-nemo-ctc-en-conformer-medium.tar.bz2
rm sherpa-onnx-nemo-ctc-en-conformer-medium.tar.bz2

python3 ./python-api-examples/non_streaming_server.py \
--nemo-ctc ./sherpa-onnx-nemo-ctc-en-conformer-medium/model.onnx \
--tokens ./sherpa-onnx-nemo-ctc-en-conformer-medium/tokens.txt \
--port 6006
```

### Start the client

#### Decode multiple files in parallel

```
python3 ./python-api-examples/offline-websocket-client-decode-files-paralell.py \
--server-addr localhost \
--server-port 6006 \
./sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/0.wav \
./sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/1.wav \
./sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/8k.wav
```

You should see the following output:

```
2023-08-11 18:31:32,432 INFO [offline-websocket-client-decode-files-paralell.py:139] {
↳ 'server_addr': 'localhost', 'server_port': 6006, 'sound_files': ['./sherpa-onnx-nemo-
↳ ctc-en-conformer-medium/test_wavs/0.wav', './sherpa-onnx-nemo-ctc-en-conformer-medium/
↳ test_wavs/1.wav', './sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/8k.wav']}
2023-08-11 18:31:32,462 INFO [offline-websocket-client-decode-files-paralell.py:113] ↵
↳ Sending ./sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/0.wav
2023-08-11 18:31:32,513 INFO [offline-websocket-client-decode-files-paralell.py:113] ↵
↳ Sending ./sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/8k.wav
2023-08-11 18:31:32,533 INFO [offline-websocket-client-decode-files-paralell.py:113] ↵
↳ Sending ./sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/1.wav
```

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```
2023-08-11 18:31:32,670 INFO [offline-websocket-client-decode-files-paralell.py:131] ./
↳sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/0.wav
after early nightfall the yellow lamps would light up here and there the squalid_
↳quarter of the brothels
2023-08-11 18:31:32,741 INFO [offline-websocket-client-decode-files-paralell.py:131] ./
↳sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/8k.wav
yet these thoughts affected hester pryne less with hope than apprehension
2023-08-11 18:31:33,117 INFO [offline-websocket-client-decode-files-paralell.py:131] ./
↳sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/1.wav
god as a direct consequence of the sin which man thus punished had given her a lovely_
↳child whose place was on that same dishonored bosom to connect her parent for ever_
↳with the race and descent of mortals and to be finally a blessed soul in heaven
```

### Decode multiple files sequentially

```
python3 ./python-api-examples/offline-websocket-client-decode-files-sequential.py \
--server-addr localhost \
--server-port 6006 \
./sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/0.wav \
./sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/1.wav \
./sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/8k.wav
```

You should see the following output:

```
2023-08-11 18:33:14,520 INFO [offline-websocket-client-decode-files-sequential.py:141] {
↳'server_addr': 'localhost', 'server_port': 6006, 'sound_files': ['./sherpa-onnx-nemo-
↳ctc-en-conformer-medium/test_wavs/0.wav', './sherpa-onnx-nemo-ctc-en-conformer-medium/
↳test_wavs/1.wav', './sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/8k.wav']}
2023-08-11 18:33:14,547 INFO [offline-websocket-client-decode-files-sequential.py:114]_
↳Sending ./sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/0.wav
after early nightfall the yellow lamps would light up here and there the squalid_
↳quarter of the brothels
2023-08-11 18:33:14,716 INFO [offline-websocket-client-decode-files-sequential.py:114]_
↳Sending ./sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/1.wav
god as a direct consequence of the sin which man thus punished had given her a lovely_
↳child whose place was on that same dishonored bosom to connect her parent for ever_
↳with the race and descent of mortals and to be finally a blessed soul in heaven
2023-08-11 18:33:15,218 INFO [offline-websocket-client-decode-files-sequential.py:114]_
↳Sending ./sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/8k.wav
yet these thoughts affected hester pryne less with hope than apprehension
```

### Non-streaming Whisper tiny.en

#### Start the server

```
cd /path/to/sherpa-onnx
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
↳whisper-tiny.en.tar.bz2
tar xvf sherpa-onnx-whisper-tiny.en.tar.bz2
rm sherpa-onnx-whisper-tiny.en.tar.bz2
```

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```
python3 ./python-api-examples/non_streaming_server.py \
--whisper-encoder=./sherpa-onnx-whisper-tiny.en/tiny.en-encoder.onnx \
--whisper-decoder=./sherpa-onnx-whisper-tiny.en/tiny.en-decoder.onnx \
--tokens=./sherpa-onnx-whisper-tiny.en/tiny.en-tokens.txt \
--port 6006
```

## Start the client

### Decode multiple files in parallel

```
python3 ./python-api-examples/offline-websocket-client-decode-files-paralell.py \
--server-addr localhost \
--server-port 6006 \
./sherpa-onnx-whisper-tiny.en/test_wavs/0.wav \
./sherpa-onnx-whisper-tiny.en/test_wavs/1.wav \
./sherpa-onnx-whisper-tiny.en/test_wavs/8k.wav
```

You should see the following output:

```
2023-08-11 18:35:28,866 INFO [offline-websocket-client-decode-files-paralell.py:139] {
    ↵'server_addr': 'localhost', 'server_port': 6006, 'sound_files': ['./sherpa-onnx-
    ↵whisper-tiny.en/test_wavs/0.wav', './sherpa-onnx-whisper-tiny.en/test_wavs/1.wav', './
    ↵sherpa-onnx-whisper-tiny.en/test_wavs/8k.wav']}
2023-08-11 18:35:28,894 INFO [offline-websocket-client-decode-files-paralell.py:113] ↵
    ↵Sending ./sherpa-onnx-whisper-tiny.en/test_wavs/0.wav
2023-08-11 18:35:28,947 INFO [offline-websocket-client-decode-files-paralell.py:113] ↵
    ↵Sending ./sherpa-onnx-whisper-tiny.en/test_wavs/1.wav
2023-08-11 18:35:29,082 INFO [offline-websocket-client-decode-files-paralell.py:113] ↵
    ↵Sending ./sherpa-onnx-whisper-tiny.en/test_wavs/8k.wav
2023-08-11 18:35:29,754 INFO [offline-websocket-client-decode-files-paralell.py:131] ./
    ↵sherpa-onnx-whisper-tiny.en/test_wavs/0.wav
    After early nightfall, the yellow lamps would light up here and there, the squalid,
    ↵quarter of the brothels.
2023-08-11 18:35:30,276 INFO [offline-websocket-client-decode-files-paralell.py:131] ./
    ↵sherpa-onnx-whisper-tiny.en/test_wavs/8k.wav
    Yet these thoughts affected Hester Prin less with hope than apprehension.
2023-08-11 18:35:31,592 INFO [offline-websocket-client-decode-files-paralell.py:131] ./
    ↵sherpa-onnx-whisper-tiny.en/test_wavs/1.wav
    God, as a direct consequence of the sin which man thus punished, had given her a lovely,
    ↵child, whose place was on that same dishonored bosom to connect her parent forever,
    ↵with the race and descent of mortals, and to be finally a blessed soul in heaven.
```

### Decode multiple files sequentially

```
python3 ./python-api-examples/offline-websocket-client-decode-files-sequential.py \
--server-addr localhost \
--server-port 6006 \
./sherpa-onnx-whisper-tiny.en/test_wavs/0.wav \
./sherpa-onnx-whisper-tiny.en/test_wavs/1.wav \
./sherpa-onnx-whisper-tiny.en/test_wavs/8k.wav
```

You should see the following output:

```
2023-08-11 18:36:42,148 INFO [offline-websocket-client-decode-files-sequential.py:141] {
  ↵'server_addr': 'localhost', 'server_port': 6006, 'sound_files': ['./sherpa-onnx-
  ↵whisper-tiny.en/test_wavs/0.wav', './sherpa-onnx-whisper-tiny.en/test_wavs/1.wav', './
  ↵sherpa-onnx-whisper-tiny.en/test_wavs/8k.wav']}
2023-08-11 18:36:42,176 INFO [offline-websocket-client-decode-files-sequential.py:114] ↵
  ↵Sending ./sherpa-onnx-whisper-tiny.en/test_wavs/0.wav
  After early nightfall, the yellow lamps would light up here and there, the squalid
  ↵quarter of the brothels.
2023-08-11 18:36:42,926 INFO [offline-websocket-client-decode-files-sequential.py:114] ↵
  ↵Sending ./sherpa-onnx-whisper-tiny.en/test_wavs/1.wav
  God, as a direct consequence of the sin which man thus punished, had given her a lovely
  ↵child, whose place was on that same dishonored bosom to connect her parent forever
  ↵with the race and descent of mortals, and to be finally a blessed soul in heaven.
2023-08-11 18:36:44,314 INFO [offline-websocket-client-decode-files-sequential.py:114] ↵
  ↵Sending ./sherpa-onnx-whisper-tiny.en/test_wavs/8k.wav
  Yet these thoughts affected Hester Prin less with hope than apprehension.
```

## colab

We provide a colab notebook for you to try the Python non-streaming websocket server example of [sherpa-onnx](#).

## 8.5 C API

In this section, we describe how to use the C API of [sherpa-onnx](#).

Specifically, we will describe:

- How to generate required files
- How to use `pkg-config` with [sherpa-onnx](#)

You can find the implementation at

- <https://github.com/k2-fsa/sherpa-onnx/blob/master/sherpa-onnx/c-api/c-api.h>
- <https://github.com/k2-fsa/sherpa-onnx/blob/master/sherpa-onnx/c-api/c-api.cc>

### 8.5.1 Generate required files

Before using the C API of [sherpa-onnx](#), we need to first build required libraries. You can choose either to build static libraries or shared libraries.

## Build shared libraries

Assume that we want to put library files and header files in the directory `/tmp/sherpa-onnx/shared`:

```
git clone https://github.com/k2-fsa/sherpa-onnx
cd sherpa-onnx
mkdir build-shared
cd build-shared

cmake \
-DSHERPA_ONNX_ENABLE_C_API=ON \
-DCMAKE_BUILD_TYPE=Release \
-DBUILD_SHARED_LIBS=ON \
-DCMAKE_INSTALL_PREFIX=/tmp/sherpa-onnx/shared \
..

make -j6
make install
```

You should find the following files inside `/tmp/sherpa-onnx/shared`:

macOS

Linux

```
$ tree /tmp/sherpa-onnx/shared/
/tmp/sherpa-onnx/shared/
    bin
        ├── sherpa-onnx
        ├── sherpa-onnx-microphone
        ├── sherpa-onnx-microphone-offline
        ├── sherpa-onnx-offline
        ├── sherpa-onnx-offline-websocket-server
        ├── sherpa-onnx-online-websocket-client
        └── sherpa-onnx-online-websocket-server
    include
        ├── cargs.h
        └── sherpa-onnx
            └── c-api
                └── c-api.h
    lib
        ├── cargs.h
        ├── libcargs.dylib
        ├── libkaldi-native-fbank-core.dylib
        ├── libonnxruntime.1.15.1.dylib
        ├── libonnxruntime.dylib -> libonnxruntime.1.15.1.dylib
        ├── libsherpa-onnx-c-api.dylib
        ├── libsherpa-onnx-core.dylib
        └── libsherpa-onnx-portaudio.dylib
    sherpa-onnx.pc

5 directories, 18 files
```

```
$ tree /tmp/sherpa-onnéx/shared/
/tmp/sherpa-onnéx/shared/
|-- bin
|   |-- sherpa-onnéx
|   |-- sherpa-onnéx-alsa
|   |-- sherpa-onnéx-microphone
|   |-- sherpa-onnéx-microphone-offline
|   |-- sherpa-onnéx-offline
|   |-- sherpa-onnéx-offline-websocket-server
|   |-- sherpa-onnéx-online-websocket-client
|   `-- sherpa-onnéx-online-websocket-server
|-- include
|   |-- cargs.h
|   |-- sherpa-onnéx
|   |   '-- c-api
|   |       '-- c-api.h
|-- lib
|   |-- cargs.h
|   |-- libcargs.so
|   |-- libkaldi-native-fbank-core.so
|   |-- libonnéxruntime.so -> libonnéxruntime.so.1.15.1
|   |-- libonnéxruntime.so.1.15.1
|   |-- libsherpa-onnéx-c-api.so
|   |-- libsherpa-onnéx-core.so
|   '-- libsherpa-onnéx-portaudio.so
`-- sherpa-onnéx.pc

5 directories, 19 files
```

## Build static libraries

Assume that we want to put library files and header files in the directory `/tmp/sherpa-onnéx/static`:

```
git clone https://github.com/k2-fsa/sherpa-onnéx
cd sherpa-onnéx
mkdir build-static
cd build-static

cmake \
-DSHERPA_ONNX_ENABLE_C_API=ON \
-DCMAKE_BUILD_TYPE=Release \
-DBUILD_SHARED_LIBS=OFF \
-DCMAKE_INSTALL_PREFIX=/tmp/sherpa-onnéx/static \
.

make -j6
make install
```

You should find the following files in `/tmp/sherpa-onnéx/static`:

macOS

Linux

```
$ tree /tmp/sherpa-onnx/static/
```

```
/tmp/sherpa-onnx//static/
├── bin
│   ├── sherpa-onnx
│   ├── sherpa-onnx-microphone
│   ├── sherpa-onnx-microphone-offline
│   ├── sherpa-onnx-offline
│   ├── sherpa-onnx-offline-websocket-server
│   ├── sherpa-onnx-online-websocket-client
│   └── sherpa-onnx-online-websocket-server
├── include
│   ├── cargs.h
│   └── sherpa-onnx
│       └── c-api
│           └── c-api.h
└── lib
    ├── cargs.h
    ├── libcargs.a
    ├── libkaldi-native-fbank-core.a
    ├── libbonnxruntime.1.15.1.dylib
    ├── libbonnxruntime.dylib -> libbonnxruntime.1.15.1.dylib
    ├── libsherpa-onnx-c-api.a
    ├── libsherpa-onnx-core.a
    └── libsherpa-onnx-portaudio_static.a
    sherpa-onnx.pc
```

5 directories, 18 files

```
$ tree /tmp/sherpa-onnx/static/
```

```
/tmp/sherpa-onnx/static/
|-- bin
|   |-- sherpa-onnx
|   |-- sherpa-onnx-alsa
|   |-- sherpa-onnx-microphone
|   |-- sherpa-onnx-microphone-offline
|   |-- sherpa-onnx-offline
|   |-- sherpa-onnx-offline-websocket-server
|   |-- sherpa-onnx-online-websocket-client
|   `-- sherpa-onnx-online-websocket-server
|-- include
|   |-- cargs.h
|   `-- sherpa-onnx
|       '-- c-api
|           '-- c-api.h
|-- lib
|   |-- cargs.h
|   |-- libcargs.a
|   |-- libkaldi-native-fbank-core.a
|   `-- libbonnxruntime.so -> libbonnxruntime.so.1.15.1
```

(continues on next page)

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```

|   |-- libonnxruntime.so.1.15.1
|   |-- libsherpa-onnx-c-api.a
|   |-- libsherpa-onnx-core.a
|   `-- libsherpa-onnx-portaudio_static.a
`-- sherpa-onnx.pc

5 directories, 19 files

```

### 8.5.2 Build decode-file-c-api.c with generated files

To build the following file:

```
https://github.com/k2-fsa/sherpa-onnx/blob/master/c-api-examples/decode-file-c-api.c
```

We can use:

static link

dynamic link

```

export PKG_CONFIG_PATH=/tmp/sherpa-onnx/static:$PKG_CONFIG_PATH

cd ./c-api-examples
gcc -o decode-file-c-api $(pkg-config --cflags sherpa-onnx) ./decode-file-c-api.c $(pkg-
config --libs sherpa-onnx)

./decode-file-c-api --help

```

```

export PKG_CONFIG_PATH=/tmp/sherpa-onnx/shared:$PKG_CONFIG_PATH

cd ./c-api-examples
gcc -o decode-file-c-api $(pkg-config --cflags sherpa-onnx) ./decode-file-c-api.c $(pkg-
config --libs sherpa-onnx)

./decode-file-c-api --help

```

### 8.5.3 colab

We provide a colab notebook for you to try the C API of `sherpa-onnx`.

## 8.6 Java API

In this section, we describe how to use the Java API of `sherpa-onnx`.

The core part of `sherpa-onnx` is written in C++. We have provided `JNI` interface for `sherpa-onnx` so that you can use it in Java.

Before using the Java API of `sherpa-onnx`, you have to build the `JNI` interface.

### 8.6.1 Build JNI interface (macOS)

In the following, we describe how to build the JNI interface for macOS. It is applicable for both macOS x64 and arm64.

For Linux users, please refer to [Build JNI interface \(Linux\)](#)

---

**Hint:** For Windows users, you have to modify the commands by yourself.

---

#### Setup the environment

Make sure you have the following two items ready:

- a working C/C++ compiler that supports C++17
- you are able to run `java` and `javac` commands in your terminal.

To check your environment, please run:

```
gcc --version
java -version
javac -version
```

The above three commands print the following output on my computer. You don't need to use the exact versions as I am using.

```
# output of gcc --version

Apple clang version 14.0.0 (clang-1400.0.29.202)
Target: x86_64-apple-darwin22.2.0
Thread model: posix
InstalledDir: /Applications/Xcode.app/Contents/Developer/Toolchains/XcodeDefault.
  ↵xctoolchain/usr/bin

# output of java -version

openjdk version "19.0.1" 2022-10-18
OpenJDK Runtime Environment (build 19.0.1+10-21)
OpenJDK 64-Bit Server VM (build 19.0.1+10-21, mixed mode, sharing)

# output of javac -version

javac 19.0.1
```

#### Build sherpa-onnx

Please use the following commands to build sherpa-onnx:

```
git clone https://github.com/k2-fsa/sherpa-onnx
cd sherpa-onnx
mkdir build
```

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(continued from previous page)

```
cd build

cmake \
-DSHERPA_ONNX_ENABLE_PYTHON=OFF \
-DSHERPA_ONNX_ENABLE_TESTS=OFF \
-DSHERPA_ONNX_ENABLE_CHECK=OFF \
-DBUILD_SHARED_LIBS=ON \
-DSHERPA_ONNX_ENABLE_PORTAUDIO=OFF \
-DSHERPA_ONNX_ENABLE_JNI=ON \
.

make -j4

ls -lh lib
```

You should see the following output for `ls -lh lib`:

```
total 11576
-rwxr-xr-x 1 fangjun staff 33K May 15 11:24 libcargs.dylib
-rwxr-xr-x 1 fangjun staff 350K May 15 11:24 libespeak-ng.dylib
-rwxr-xr-x 1 fangjun staff 471K May 15 11:24 libkaldi-decoder-core.dylib
-rwxr-xr-x 1 fangjun staff 113K May 15 11:24 libkaldi-native-fbank-core.dylib
-rwxr-xr-x 1 fangjun staff 423K May 15 11:24 libpiper_phonemize.1.2.0.dylib
lrwxr-xr-x 1 fangjun staff 30B May 15 11:24 libpiper_phonemize.1.dylib -> libpiper_
↳ phonemize.1.2.0.dylib
lrwxr-xr-x 1 fangjun staff 26B May 15 11:24 libpiper_phonemize.dylib -> libpiper_
↳ phonemize.1.dylib
-rwxr-xr-x 1 fangjun staff 113K May 15 11:25 libsherpa-onnx-c-api.dylib
-rwxr-xr-x 1 fangjun staff 1.8M May 15 11:24 libsherpa-onnx-core.dylib
-rwxr-xr-x 1 fangjun staff 1.5M May 15 11:24 libsherpa-onnx-fst.6.dylib
lrwxr-xr-x 1 fangjun staff 26B May 15 11:24 libsherpa-onnx-fst.dylib -> libsherpa-
↳ onnx-fst.6.dylib
-rwxr-xr-x 1 fangjun staff 34K May 15 11:24 libsherpa-onnx-fstfar.7.dylib
lrwxr-xr-x 1 fangjun staff 29B May 15 11:24 libsherpa-onnx-fstfar.dylib ->_
↳ libsherpa-onnx-fstfar.7.dylib
-rwxr-xr-x 1 fangjun staff 127K May 15 11:25 libsherpa-onnx-jni.dylib
-rwxr-xr-x 1 fangjun staff 933K May 15 11:24 libsherpa-onnx-kaldifst-core.dylib
-rwxr-xr-x 1 fangjun staff 187K May 15 11:24 libucd.dylib
```

Note that all these `*.dylib` files are required.

`libsherpa-onnx-jni.dylib` contains the JNI interface for `sherpa-onnx`.

## 8.6.2 Build JNI interface (Linux)

In the following, we describe how to build the JNI interface for Linux. It is applicable for both Linux x64 and arm64.

For macOS users, please refer to [Build JNI interface \(macOS\)](#)

---

**Hint:** For Windows users, you have to modify the commands by yourself.

---

### Setup the environment

Make sure you have the following two items ready:

- a working C/C++ compiler that supports C++17
- you are able to run `java` and `javac` commands in your terminal.

To check your environment, please run:

```
gcc --version
java -version
javac -version
```

The above three commands print the following output on my computer. You don't need to use the exact versions as I am using.

```
# output of gcc --version

gcc (Ubuntu 12.3.0-1ubuntu1~23.04) 12.3.0
Copyright (C) 2022 Free Software Foundation, Inc.
This is free software; see the source for copying conditions. There is NO
warranty; not even for MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.

# output of java -version

java version "17.0.11" 2024-04-16 LTS
Java(TM) SE Runtime Environment (build 17.0.11+7-LTS-207)
Java HotSpot(TM) 64-Bit Server VM (build 17.0.11+7-LTS-207, mixed mode, sharing)

# output of javac -version

javac 17.0.11
```

### Build sherpa-onnx

Please use the following commands to build `sherpa-onnx`:

```
git clone https://github.com/k2-fsa/sherpa-onnx
cd sherpa-onnx
mkdir build
```

(continues on next page)

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```
cd build

cmake \
-DSHERPA_ONNX_ENABLE_PYTHON=OFF \
-DSHERPA_ONNX_ENABLE_TESTS=OFF \
-DSHERPA_ONNX_ENABLE_CHECK=OFF \
-DBUILD_SHARED_LIBS=ON \
-DSHERPA_ONNX_ENABLE_PORTAUDIO=OFF \
-DSHERPA_ONNX_ENABLE_JNI=ON \
.

.

make -j4

ls -lh lib
```

You should see the following output for `ls -lh lib`:

```
total 7.7M
-rwxrwxr-x 1 fangjun fangjun 16K May 15 03:53 libcargs.so
-rwxrwxr-x 1 fangjun fangjun 396K May 15 03:53 libespeak-ng.so
-rwxrwxr-x 1 fangjun fangjun 652K May 15 03:53 libkaldi-decoder-core.so
-rwxrwxr-x 1 fangjun fangjun 108K May 15 03:53 libkaldi-native-fbank-core.so
lrwxrwxrwx 1 fangjun fangjun 23 May 15 03:53 libpiper_phonemize.so -> libpiper_
↳ phonemize.so.1
lrwxrwxrwx 1 fangjun fangjun 27 May 15 03:53 libpiper_phonemize.so.1 -> libpiper_
↳ phonemize.so.1.2.0
-rwxrwxr-x 1 fangjun fangjun 450K May 15 03:53 libpiper_phonemize.so.1.2.0
-rwxrwxr-x 1 fangjun fangjun 107K May 15 03:55 libsherpa-onnx-c-api.so
-rwxrwxr-x 1 fangjun fangjun 2.4M May 15 03:54 libsherpa-onnx-core.so
lrwxrwxrwx 1 fangjun fangjun 26 May 15 03:53 libsherpa-onnx-fstfar.so -> libsherpa-
↳ onnx-fstfar.so.7
-rwxrwxr-x 1 fangjun fangjun 18K May 15 03:53 libsherpa-onnx-fstfar.so.7
lrwxrwxrwx 1 fangjun fangjun 23 May 15 03:53 libsherpa-onnx-fst.so -> libsherpa-onnx-
↳ fst.so.6
-rwxrwxr-x 1 fangjun fangjun 2.1M May 15 03:53 libsherpa-onnx-fst.so.6
-rwxrwxr-x 1 fangjun fangjun 134K May 15 03:55 libsherpa-onnx-jni.so
-rwxrwxr-x 1 fangjun fangjun 1.2M May 15 03:53 libsherpa-onnx-kaldifst-core.so
-rwxrwxr-x 1 fangjun fangjun 229K May 15 03:53 libucd.so
```

Note that all these `*.so` files are required.

`libsherpa-onnx-jni.so` contains the JNI interface for `sherpa-onnx`.

### 8.6.3 Build JNI interface (Windows)

Please see <https://github.com/k2-fsa/sherpa-onnx/issues/882>.

---

**Hint:** The PDFs in the above link are in Chinese.

---

### 8.6.4 Build the jar package

```
cd sherpa-onnx/sherpa-onnx/java-api
ls -lh
```

You should see the following output:

```
(py311) fangjun@ubuntu23-04:/mnt/sdb/shared/sherpa-onnx/sherpa-onnx/java-api$ ls -lh
total 8.0K
-rw-rw-r-- 1 fangjun fangjun 2.5K May  8 06:17 Makefile
drwxrwxr-x 3 fangjun fangjun 4.0K Mar  1 04:29 src
```

Please run the following command in the directory `sherpa-onnx/java-api`:

```
make
```

You should see the following output after running `make`:

```
(py311) fangjun@ubuntu23-04:/mnt/sdb/shared/sherpa-onnx/sherpa-onnx/java-api$ ls -lh
total 12K
drwxrwxr-x 3 fangjun fangjun 4.0K May 15 03:59 build
-rw-rw-r-- 1 fangjun fangjun 2.5K May  8 06:17 Makefile
drwxrwxr-x 3 fangjun fangjun 4.0K Mar  1 04:29 src
(py311) fangjun@ubuntu23-04:/mnt/sdb/shared/sherpa-onnx/sherpa-onnx/java-api$ ls -lh
build/
total 60K
drwxrwxr-x 3 fangjun fangjun 4.0K May 15 03:58 com
-rw-rw-r-- 1 fangjun fangjun 53K May 15 03:59 sherpa-onnx.jar
```

Congratulations! You have generated `sherpa-onnx.jar` successfully.

---

**Hint:** You can find the Java API source files at

<https://github.com/k2-fsa/sherpa-onnx/tree/master/sherpa-onnx/java-api/src/com/k2fsa/sherpa/onnx>

---

## 8.6.5 Examples

Please see <https://github.com/k2-fsa/sherpa-onnx/tree/master/java-api-examples>

You can find detailed instructions at

<https://github.com/k2-fsa/sherpa-onnx/blob/master/java-api-examples/README.md>

## 8.7 Javascript API

For using Javascript in the browser, please see our [WebAssembly](#) doc.

This section describes how to use `sherpa-onnx` in Node with Javascript API.

### 8.7.1 Install

We provide npm packages for `sherpa-onnx`.

It can be found at

<https://www.npmjs.com/package/sherpa-onnx-node>

---

**Hint:** It requires Node>=v16.

---

Please always use the latest version.

To install it, please run:

```
npm install sherpa-onnx-node
```

It supports the following platforms:

- Linux x64
- Linux arm64
- macOS x64
- macOS arm64
- Windows x64

---

**Hint:** You don't need to pre-install anything in order to install `sherpa-onnx-node`.

That is, you don't need to install a C/C++ compiler. You don't need to install Python. You don't need to install CMake, etc.

---

## 8.7.2 Examples

Please see <https://github.com/k2-fsa/sherpa-onnx/tree/master/nodejs-addon-examples>

You can find detailed instructions at

<https://github.com/k2-fsa/sherpa-onnx/tree/master/nodejs-addon-examples/README.md>

## 8.8 Kotlin API

In this section, we describe how to use the **Kotlin API** of `sherpa-onnx`.

The core part of `sherpa-onnx` is written in C++. We have provided **JNI** interface for `sherpa-onnx` so that you can use it in Kotlin.

Before using the Kotlin API of `sherpa-onnx`, you have to build the **JNI** interface.

### 8.8.1 Build JNI interface

For macOS users, please refer to [Build JNI interface \(macOS\)](#).

For Linux users, please refer to [Build JNI interface \(Linux\)](#).

---

**Hint:** For Windows users, you have to modify the commands by yourself.

---

### 8.8.2 Examples

Please see <https://github.com/k2-fsa/sherpa-onnx/tree/master/kotlin-api-examples>

You can find detailed instructions at

<https://github.com/k2-fsa/sherpa-onnx/blob/master/kotlin-api-examples/run.sh>

## 8.9 Swift API

### 8.9.1 Build

Please use the following script to build `sherpa-onnx` for Swift API:

<https://github.com/k2-fsa/sherpa-onnx/blob/master/build-swift-macos.sh>

The following is an example command:

```
git clone https://github.com/k2-fsa/sherpa-onnx
cd sherpa-onnx
./build-swift-macos.sh
```

## 8.9.2 Examples

Please see <https://github.com/k2-fsa/sherpa-onnx/tree/master/swift-api-examples>

Each example has a corresponding shell script. Please use the shell script to run it.

For instance,

- to run the text-to-speech example, please use <https://github.com/k2-fsa/sherpa-onnx/blob/master/swift-api-examples/run-tts.sh>
- to run the speech-to-text example, please use <https://github.com/k2-fsa/sherpa-onnx/blob/master/swift-api-examples/run-decode-file.sh>

## 8.10 Go API

In this section, we describe how to use the [Go API](#) of [sherpa-onnx](#).

The [Go API](#) of [sherpa-onnx](#) supports both streaming and non-streaming speech recognition.

The following table lists some [Go API](#) examples:

Description	URL
Decode a file with <b>non-streaming</b> models	<a href="https://github.com/k2-fsa/sherpa-onnx/tree/master/go-api-examples/non-streaming-decode-files">https://github.com/k2-fsa/sherpa-onnx/tree/master/go-api-examples/non-streaming-decode-files</a>
Decode a file with <b>streaming</b> models	<a href="https://github.com/k2-fsa/sherpa-onnx/tree/master/go-api-examples/streaming-decode-files">https://github.com/k2-fsa/sherpa-onnx/tree/master/go-api-examples/streaming-decode-files</a>
<b>Real-time</b> speech recognition from a <b>microphone</b>	<a href="https://github.com/k2-fsa/sherpa-onnx/tree/master/go-api-examples/real-time-speech-recognition-from-microphone">https://github.com/k2-fsa/sherpa-onnx/tree/master/go-api-examples/real-time-speech-recognition-from-microphone</a>

One thing to note is that we have provided pre-built libraries for [Go](#) so that you don't need to build [sherpa-onnx](#) by yourself when using the [Go API](#).

To make supporting multiple platforms easier, we split the [Go API](#) of [sherpa-onnx](#) into multiple packages, as listed in the following table:

OS	Package name	Supported Arch	Doc
Linux	<a href="#">sherpa-onnx-go-linux</a>	<code>x86_64, aarch64, arm</code>	<a href="https://pkg.go.dev/github.com/k2-fsa/sherpa-onnx-go-linux">https://pkg.go.dev/github.com/k2-fsa/sherpa-onnx-go-linux</a>
macOS	<a href="#">sherpa-onnx-go-macos</a>	<code>x86_64, aarch64</code>	<a href="https://pkg.go.dev/github.com/k2-fsa/sherpa-onnx-go-macos">https://pkg.go.dev/github.com/k2-fsa/sherpa-onnx-go-macos</a>
Windows	<a href="#">sherpa-onnx-go-windows</a>	<code>x86_64, x86</code>	<a href="https://pkg.go.dev/github.com/k2-fsa/sherpa-onnx-go-windows">https://pkg.go.dev/github.com/k2-fsa/sherpa-onnx-go-windows</a>

To simplify the usage, we have provided a single [Go](#) package for [sherpa-onnx](#) that supports multiple operating systems. It can be found at

<https://github.com/k2-fsa/sherpa-onnx-go>

**Hint:** Such a design is inspired by the following article:

[Cross platform Go modules for giants.](#)

You can use the following `import` to import [sherpa-onnx-go](#) into your [Go](#) project:

```
import (
    sherpa "github.com/k2-fsa/sherpa-onnx-go/sherpa_onnx"
)
```

In the following, we describe how to run our provided Go API examples.

---

**Note:** Before you continue, please make sure you have installed Go. If not, please follow <https://go.dev/doc/install> to install Go.

---

**Hint:** You need to enable `cgo` to build `sherpa-onnx-go`.

---

### 8.10.1 Decode files with non-streaming models

First, let us build the example:

```
git clone https://github.com/k2-fsa/sherpa-onnx
cd sherpa-onnx/go-api-examples/non-streaming-decode-files
go mod tidy
go build
./non-streaming-decode-files --help
```

You will find the following output:

```
Usage of ./non-streaming-decode-files:
  --debug int            Whether to show debug message
  --decoder string       Path to the decoder model
  --decoding-method string Decoding method. Possible values: greedy_search, ↵
  ↵modified_beam_search (default "greedy_search")
  --encoder string        Path to the encoder model
  --joiner string         Path to the joiner model
  --lm-model string       Optional. Path to the LM model
  --lm-scale float32      Optional. Scale for the LM model (default 1)
  --max-active-paths int  Used only when --decoding-method is modified_beam_
  ↵search (default 4)
  --model-type string     Optional. Used for loading the model in a faster way
  --nemo-ctc string       Path to the NeMo CTC model
  --num-threads int        Number of threads for computing (default 1)
  --paraformer string     Path to the paraformer model
  --provider string        Provider to use (default "cpu")
  --tokens string          Path to the tokens file
pflag: help requested
```

Congratulations! You have successfully built your first Go API example for speech recognition.

---

**Note:** If you are using Windows and don't see any output after running `./non-streaming-decode-files --help`, please copy `*.dll` from [https://github.com/k2-fsa/sherpa-onnx-go-windows/tree/master/lib/x86\\_64-pc-windows-gnu](https://github.com/k2-fsa/sherpa-onnx-go-windows/tree/master/lib/x86_64-pc-windows-gnu) (for Win64) or <https://github.com/k2-fsa/sherpa-onnx-go-windows/tree/master/lib/i686-pc-windows-gnu> (for Win32) to the directory `sherpa-onnx/go-api-examples/non-streaming-decode-files`.

---

Now let us refer to [Pre-trained models](#) to download a non-streaming model.

We give several examples below for demonstration.

### Non-streaming transducer

We will use [csukuangfj/sherpa-onnx-zipformer-en-2023-06-26 \(English\)](#) as an example.

First, let us download it:

```
cd sherpa-onnx/go-api-examples/non-streaming-decode-files
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
zipformer-en-2023-06-26.tar.bz2
tar xvf sherpa-onnx-zipformer-en-2023-06-26.tar.bz2
rm sherpa-onnx-zipformer-en-2023-06-26.tar.bz2
```

Now we can use:

```
./non-streaming-decode-files \
--encoder ./sherpa-onnx-zipformer-en-2023-06-26/encoder-epoch-99-avg-1.onnx \
--decoder ./sherpa-onnx-zipformer-en-2023-06-26/decoder-epoch-99-avg-1.onnx \
--joiner ./sherpa-onnx-zipformer-en-2023-06-26/joiner-epoch-99-avg-1.onnx \
--tokens ./sherpa-onnx-zipformer-en-2023-06-26/tokens.txt \
--model-type transducer \
./sherpa-onnx-zipformer-en-2023-06-26/test_wavs/0.wav
```

It should give you the following output:

```
2023/08/10 14:52:48.723098 Reading ./sherpa-onnx-zipformer-en-2023-06-26/test_wavs/0.wav
2023/08/10 14:52:48.741042 Initializing recognizer (may take several seconds)
2023/08/10 14:52:51.998848 Recognizer created!
2023/08/10 14:52:51.998870 Start decoding!
2023/08/10 14:52:52.258818 Decoding done!
2023/08/10 14:52:52.258847 after early nightfall the yellow lamps would light up here.
    and there the squalid quarter of the brothels
2023/08/10 14:52:52.258952 Wave duration: 6.625 seconds
```

### Non-streaming paraformer

We will use [csukuangfj/sherpa-onnx-paraformer-zh-2023-03-28 \(Chinese + English\)](#) as an example.

First, let us download it:

```
cd sherpa-onnx/go-api-examples/non-streaming-decode-files
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
paraformer-zh-2023-03-28.tar.bz2
tar xvf sherpa-onnx-paraformer-zh-2023-03-28.tar.bz2
rm sherpa-onnx-paraformer-zh-2023-03-28.tar.bz2
```

Now we can use:

```
./non-streaming-decode-files \
--paraformer ./sherpa-onnx-paraformer-zh-2023-03-28/model.int8.onnx \
--tokens ./sherpa-onnx-paraformer-zh-2023-03-28/tokens.txt \
```

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```
--model-type paraformer \
./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/0.wav
```

It should give you the following output:

```
2023/08/10 15:07:10.745412 Reading ./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/0.wav
2023/08/10 15:07:10.758414 Initializing recognizer (may take several seconds)
2023/08/10 15:07:13.992424 Recognizer created!
2023/08/10 15:07:13.992441 Start decoding!
2023/08/10 15:07:14.382157 Decoding done!
2023/08/10 15:07:14.382847
2023/08/10 15:07:14.382898 Wave duration: 5.614625 seconds
```

## Non-streaming CTC model from NeMo

We will use *stt\_en\_conformer\_ctc\_medium* as an example.

First, let us download it:

```
cd sherpa-onnx/go-api-examples/non-streaming-decode-files
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-nemo-
↪ ctc-en-conformer-medium.tar.bz2
tar xvf sherpa-onnx-nemo-ctc-en-conformer-medium.tar.bz2
rm sherpa-onnx-nemo-ctc-en-conformer-medium.tar.bz2
```

Now we can use:

```
./non-streaming-decode-files \
--nemo-ctc ./sherpa-onnx-nemo-ctc-en-conformer-medium/model.onnx \
--tokens ./sherpa-onnx-nemo-ctc-en-conformer-medium/tokens.txt \
--model-type nemo_ctc \
./sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/0.wav
```

It should give you the following output:

```
2023/08/10 15:11:48.667693 Reading ./sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/
↪ 0.wav
2023/08/10 15:11:48.680855 Initializing recognizer (may take several seconds)
2023/08/10 15:11:51.900852 Recognizer created!
2023/08/10 15:11:51.900869 Start decoding!
2023/08/10 15:11:52.125605 Decoding done!
2023/08/10 15:11:52.125630 after early nightfall the yellow lamps would light up here_
↪ and there the squalid quarter of the brothels
2023/08/10 15:11:52.125645 Wave duration: 6.625 seconds
```

## 8.10.2 Decode files with streaming models

First, let us build the example:

```
git clone https://github.com/k2-fsa/sherpa-onnx
cd sherpa-onnx/go-api-examples/streaming-decode-files
go mod tidy
go build
./streaming-decode-files --help
```

You will find the following output:

```
Usage of ./streaming-decode-files:
  --debug int            Whether to show debug message
  --decoder string       Path to the decoder model
  --decoding-method string Decoding method. Possible values: greedy_search, u
  ↵modified_beam_search (default "greedy_search")
    --encoder string      Path to the encoder model
    --joiner string        Path to the joiner model
    --max-active-paths int Used only when --decoding-method is modified_beam_
  ↵search (default 4)
    --model-type string   Optional. Used for loading the model in a faster way
    --num-threads int     Number of threads for computing (default 1)
    --provider string     Provider to use (default "cpu")
    --tokens string        Path to the tokens file
pflag: help requested
```

---

**Note:** If you are using Windows and don't see any output after running `./streaming-decode-files --help`, please copy `*.dll` from [https://github.com/k2-fsa/sherpa-onnx-go-windows/tree/master/lib/x86\\_64-pc-windows-gnu](https://github.com/k2-fsa/sherpa-onnx-go-windows/tree/master/lib/x86_64-pc-windows-gnu) (for Win64) or <https://github.com/k2-fsa/sherpa-onnx-go-windows/tree/master/lib/i686-pc-windows-gnu> (for Win32) to the directory `sherpa-onnx/go-api-examples/streaming-decode-files`.

---

Now let us refer to [Pre-trained models](#) to download a streaming model.

We give one example below for demonstration.

### Streaming transducer

We will use [csukuangji/sherpa-onnx-streaming-zipformer-en-2023-06-26 \(English\)](https://github.com/csukuangji/sherpa-onnx-streaming-zipformer-en-2023-06-26) as an example.

First, let us download it:

```
cd sherpa-onnx/go-api-examples/streaming-decode-files
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
  ↵streaming-zipformer-en-2023-06-26.tar.bz2
tar xvf sherpa-onnx-streaming-zipformer-en-2023-06-26.tar.bz2
rm sherpa-onnx-streaming-zipformer-en-2023-06-26.tar.bz2
```

Now we can use:

```
./streaming-decode-files \
  --encoder ./sherpa-onnx-streaming-zipformer-en-2023-06-26/encoder-epoch-99-avg-1-chunk-
  ↵16-left-128.onnx \
```

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```
--decoder ./sherpa-onnx-streaming-zipformer-en-2023-06-26/decoder-epoch-99-avg-1-chunk-  
↪16-left-128.onnx \  
--joiner ./sherpa-onnx-streaming-zipformer-en-2023-06-26/joiner-epoch-99-avg-1-chunk-  
↪16-left-128.onnx \  
--tokens ./sherpa-onnx-streaming-zipformer-en-2023-06-26/tokens.txt \  
--model-type zipformer2 \  
./sherpa-onnx-streaming-zipformer-en-2023-06-26/test_wavs/0.wav
```

It should give you the following output:

```
2023/08/10 15:17:00.226228 Reading ./sherpa-onnx-streaming-zipformer-en-2023-06-26/test_  
↪wavs/0.wav  
2023/08/10 15:17:00.241024 Initializing recognizer (may take several seconds)  
2023/08/10 15:17:03.352697 Recognizer created!  
2023/08/10 15:17:03.352711 Start decoding!  
2023/08/10 15:17:04.057130 Decoding done!  
2023/08/10 15:17:04.057215 after early nightfall the yellow lamps would light up here.  
↪and there the squalid quarter of the brothels  
2023/08/10 15:17:04.057235 Wave duration: 6.625 seconds
```

### 8.10.3 Real-time speech recognition from microphone

---

**Hint:** You need to install portaudio for this example.

```
# for macOS  
brew install portaudio  
export PKG_CONFIG_PATH=/usr/local/Cellar/portaudio/19.7.0  
  
# for Ubuntu  
sudo apt-get install libasound-dev portaudio19-dev libportaudio2 libportaudiocpp0
```

To check that you have installed portaudio successfully, please run:

```
pkg-config --cflags --libs portaudio-2.0
```

It should give you something like below:

```
# for macOS  
-I/usr/local/Cellar/portaudio/19.7.0/include -L/usr/local/Cellar/portaudio/19.  
↪7.0/lib -lportaudio -framework CoreAudio -framework AudioToolbox -framework  
↪AudioUnit -framework CoreFoundation -framework CoreServices  
  
# for Ubuntu  
-pthread -lportaudio -lasound -lm -lpthread
```

---

First, let us build the example:

```
git clone https://github.com/k2-fsa/sherpa-onnx  
cd sherpa-onnx/go-api-examples/real-time-speech-recognition-from-microphone  
go mod tidy
```

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```
go build
./real-time-speech-recognition-from-microphone --help
```

You will find the following output:

```
Select default input device: MacBook Pro Microphone
Usage of ./real-time-speech-recognition-from-microphone:
  --debug int                                Whether to show debug message
  --decoder string                            Path to the decoder model
  --decoding-method string                   Decoding method. Possible values: greedy_
  ↵search, modified_beam_search (default "greedy_search")
    --enable-endpoint int                    Whether to enable endpoint (default 1)
    --encoder string                        Path to the encoder model
    --joiner string                         Path to the joiner model
    --max-active-paths int                  Used only when --decoding-method is_
  ↵modified_beam_search (default 4)
    --model-type string                   Optional. Used for loading the model in a_
  ↵faster way
    --num-threads int                     Number of threads for computing (default 1)
    --provider string                     Provider to use (default "cpu")
    --rule1-min-trailing-silence float32  Threshold for rule1 (default 2.4)
    --rule2-min-trailing-silence float32  Threshold for rule2 (default 1.2)
    --rule3-min-utterance-length float32  Threshold for rule3 (default 20)
    --tokens string                        Path to the tokens file
pflag: help requested
```

Now let us refer to [Pre-trained models](#) to download a streaming model.

We give one example below for demonstration.

## Streaming transducer

We will use [csukuangfj/sherpa-onnx-streaming-zipformer-en-2023-06-26 \(English\)](#) as an example.

First, let us download it:

```
cd sherpa-onnx/go-api-examples/real-time-speech-recognition-from-microphone
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
  ↵streaming-zipformer-en-2023-06-26.tar.bz2
tar xvf sherpa-onnx-streaming-zipformer-en-2023-06-26.tar.bz2
rm sherpa-onnx-streaming-zipformer-en-2023-06-26.tar.bz2
```

Now we can use:

```
./real-time-speech-recognition-from-microphone \
  --encoder ./sherpa-onnx-streaming-zipformer-en-2023-06-26/encoder-epoch-99-avg-1-chunk-
  ↵16-left-128.onnx \
  --decoder ./sherpa-onnx-streaming-zipformer-en-2023-06-26/decoder-epoch-99-avg-1-chunk-
  ↵16-left-128.onnx \
  --joiner ./sherpa-onnx-streaming-zipformer-en-2023-06-26/joiner-epoch-99-avg-1-chunk-
  ↵16-left-128.onnx \
  --tokens ./sherpa-onnx-streaming-zipformer-en-2023-06-26/tokens.txt \
  --model-type zipformer2
```

It should give you the following output:

```
Select default input device: MacBook Pro Microphone
2023/08/10 15:22:00 Initializing recognizer (may take several seconds)
2023/08/10 15:22:03 Recognizer created!
Started! Please speak
0: this is the first test
1: this is the second
```

## 8.10.4 colab

We provide a colab notebook for you to try the Go API examples of `sherpa-onnx`.

## 8.11 C# API

In this section, we describe how to use the C# API examples of `sherpa-onnx`.

The C# API of `sherpa-onnx` supports both streaming and non-streaming speech recognition.

The following table lists some C# API examples:

Description	URL
Decode a file with <b>non-streaming</b> models	<a href="https://github.com/k2-fsa/sherpa-onnx/tree/master/dotnet-examples/offline-decode-files">https://github.com/k2-fsa/sherpa-onnx/tree/master/dotnet-examples/offline-decode-files</a>
Decode a file with <b>streaming</b> models	<a href="https://github.com/k2-fsa/sherpa-onnx/tree/master/dotnet-examples/online-decode-files">https://github.com/k2-fsa/sherpa-onnx/tree/master/dotnet-examples/online-decode-files</a>
<b>Real-time</b> speech recognition from a <b>microphone</b>	<a href="https://github.com/k2-fsa/sherpa-onnx/tree/master/dotnet-examples/speech-recognition-from-microphone">https://github.com/k2-fsa/sherpa-onnx/tree/master/dotnet-examples/speech-recognition-from-microphone</a>

You can find the implementation in the following files:

- API for **streaming** speech recognition  
<https://github.com/k2-fsa/sherpa-onnx/blob/master/scripts/dotnet/online.cs>
- API for **non-streaming** speech recognition  
<https://github.com/k2-fsa/sherpa-onnx/blob/master/scripts/dotnet/offline.cs>

We also provide a nuget package for `sherpa-onnx`:

<https://www.nuget.org/packages/org.k2fsa.sherpa.onnx>

You can use the following statement in your `csproj` file to introduce the dependency on `sherpa-onnx`:

```
<PackageReference Include="org.k2fsa.sherpa.onnx" Version="*"/>
```

One thing to note is that we have provided pre-built libraries for C# so that you don't need to build `sherpa-onnx` by yourself when using the C# API.

In the following, we describe how to run our provided C# API examples.

---

**Note:** Before you continue, please make sure you have installed .Net. If not, please follow <https://dotnet.microsoft.com/en-us/download> to install .Net.

---

---

**Hint:** .Net supports Windows, macOS, and Linux.

---

### 8.11.1 Decode files with non-streaming models

First, let us build the example:

```
git clone https://github.com/k2-fsa/sherpa-onnx
cd sherpa-onnx/dotnet-examples/offline-decode-files/
dotnet build -c Release
./bin/Release/net6.0/offline-decode-files --help
```

You will find the following output:

```
# Zipformer

dotnet run \
--tokens=./sherpa-onnx-zipformer-en-2023-04-01/tokens.txt \
--encoder=./sherpa-onnx-zipformer-en-2023-04-01/encoder-epoch-99-avg-1.onnx \
--decoder=./sherpa-onnx-zipformer-en-2023-04-01/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-zipformer-en-2023-04-01/joiner-epoch-99-avg-1.onnx \
--files ./sherpa-onnx-zipformer-en-2023-04-01/test_wavs/0.wav \
./sherpa-onnx-zipformer-en-2023-04-01/test_wavs/1.wav \
./sherpa-onnx-zipformer-en-2023-04-01/test_wavs/8k.wav

Please refer to
https://k2-fsa.github.io/sherpa/onnx/pretrained\_models/offline-transducer/index.html
to download pre-trained non-streaming zipformer models.

# Paraformer

dotnet run \
--tokens=./sherpa-onnx-paraformer-zh-2023-03-28/tokens.txt \
--paraformer=./sherpa-onnx-paraformer-zh-2023-03-28/model.onnx \
--files ./sherpa-onnx-zipformer-en-2023-04-01/test_wavs/0.wav \
./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/0.wav \
./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/1.wav \
./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/2.wav \
./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/8k.wav

Please refer to
https://k2-fsa.github.io/sherpa/onnx/pretrained\_models/offline-paraformer/index.html
to download pre-trained paraformer models

# NeMo CTC

dotnet run \
--tokens=./sherpa-onnx-nemo-ctc-en-conformer-medium/tokens.txt \
--nemo-ctc=./sherpa-onnx-nemo-ctc-en-conformer-medium/model.onnx \
--num-threads=1 \
--files ./sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/0.wav \
./sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/1.wav \
./sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/8k.wav
```

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Please refer to  
[https://k2-fsa.github.io/sherpa/onnx/pretrained\\_models/offline-ctc/index.html](https://k2-fsa.github.io/sherpa/onnx/pretrained_models/offline-ctc/index.html)  
to download pre-trained paraformer models

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--tokens	Path to tokens.txt
--encoder	Path to encoder.onnx. Used only <b>for</b> transducer models
--decoder	Path to decoder.onnx. Used only <b>for</b> transducer models
--joiner	Path to joiner.onnx. Used only <b>for</b> transducer models
--paraformer	Path to model.onnx. Used only <b>for</b> paraformer models
--nemo-ctc	Path to model.onnx. Used only <b>for</b> NeMo CTC models
--num-threads	(Default: 1) Number of threads <b>for</b> computation
--decoding-method	(Default: greedy_search) Valid decoding methods are: greedy_search, modified_beam_search
--max-active-paths	(Default: 4) Used only when --decoding--method is modified_beam_search. It specifies number of active paths to keep during the search
--files	Required. Audio files <b>for</b> decoding
--help	Display this <b>help</b> screen.
--version	Display version information.

Now let us refer to *Pre-trained models* to download a non-streaming model.

We give several examples below for demonstration.

## Non-streaming transducer

We will use *csukuangfj/sherpa-onné-zipformer-en-2023-06-26 (English)* as an example.

First, let us download it:

```
cd sherpa-onné/dotnet-examples/offline-decode-files
wget https://github.com/k2-fsa/sherpa-onné/releases/download/asr-models/sherpa-onné-
zipformer-en-2023-06-26.tar.bz2
tar xvf sherpa-onné-zipformer-en-2023-06-26.tar.bz2
rm sherpa-onné-zipformer-en-2023-06-26.tar.bz2
```

Now we can use:

```
dotnet run -c Release \
--encoder ./sherpa-onné-zipformer-en-2023-06-26/encoder-epoch-99-avg-1.onnx \
--decoder ./sherpa-onné-zipformer-en-2023-06-26/decoder-epoch-99-avg-1.onnx \
--joiner ./sherpa-onné-zipformer-en-2023-06-26/joiner-epoch-99-avg-1.onnx \
--tokens ./sherpa-onné-zipformer-en-2023-06-26/tokens.txt \
--files ./sherpa-onné-zipformer-en-2023-06-26/test_wavs/0.wav \
./sherpa-onné-zipformer-en-2023-06-26/test_wavs/1.wav \
./sherpa-onné-zipformer-en-2023-06-26/test_wavs/8k.wav
```

It should give you the following output:

```

./Users/runner/work/sherpa-onnx/sherpa-onnx/sherpa-onnx/csrc/offline-stream.
↳ cc:AcceptWaveformImpl:117 Creating a resampler:
  in_sample_rate: 8000
  output_sample_rate: 16000

-----
./sherpa-onnx-zipformer-en-2023-06-26/test_wavs/0.wav
AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID
↳ QUARTER OF THE BROTHELS

-----
./sherpa-onnx-zipformer-en-2023-06-26/test_wavs/1.wav
GOD AS A DIRECT CONSEQUENCE OF THE SIN WHICH MAN THUS PUNISHED HAD GIVEN HER A LOVELY
↳ CHILD WHOSE PLACE WAS ON THAT SAME DISHONORED BOSOM TO CONNECT HER PARENT FOREVER WITH
↳ THE RACE AND DESCENT OF MORTALS AND TO BE FINALLY A BLESSED SOUL IN HEAVEN

-----
./sherpa-onnx-zipformer-en-2023-06-26/test_wavs/8k.wav
YET THESE THOUGHTS AFFECTED HESTER PRYNNE LESS WITH HOPE THAN APPREHENSION
-----
```

## Non-streaming paraformer

We will use [csukuangfj/sherpa-onnx-paraformer-zh-2023-03-28](https://github.com/csukuangfj/sherpa-onnx-paraformer-zh-2023-03-28) (*Chinese + English*) as an example.

First, let us download it:

```

cd sherpa-onnx/dotnet-examples/offline-decode-files
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
↳ -paraformer-zh-2023-03-28.tar.bz2
tar xvf sherpa-onnx-paraformer-zh-2023-03-28.tar.bz2
rm sherpa-onnx-paraformer-zh-2023-03-28.tar.bz2
```

Now we can use:

```

dotnet run -c Release \
  --paraformer ./sherpa-onnx-paraformer-zh-2023-03-28/model.int8.onnx \
  --tokens ./sherpa-onnx-paraformer-zh-2023-03-28/tokens.txt \
  --files ./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/0.wav \
  ./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/1.wav \
  ./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/8k.wav
```

It should give you the following output:

```

./Users/runner/work/sherpa-onnx/sherpa-onnx/sherpa-onnx/csrc/offline-stream.
↳ cc:AcceptWaveformImpl:117 Creating a resampler:
  in_sample_rate: 8000
  output_sample_rate: 16000

-----
./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/0.wav

-----
./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/1.wav
```

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```
-----  
./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/8k.wav  
-----
```

### Non-streaming CTC model from NeMo

We will use *stt\_en\_conformer\_ctc\_medium* as an example.

First, let us download it:

```
cd sherpa-onnx/dotnet-examples/offline-decode-files  
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-nemo-  
-ctc-en-conformer-medium.tar.bz2  
tar xvf sherpa-onnx-nemo-ctc-en-conformer-medium.tar.bz2  
rm sherpa-onnx-nemo-ctc-en-conformer-medium.tar.bz2
```

Now we can use:

```
dotnet run -c Release \  
  --nemo-ctc ./sherpa-onnx-nemo-ctc-en-conformer-medium/model.onnx \  
  --tokens ./sherpa-onnx-nemo-ctc-en-conformer-medium/tokens.txt \  
  --files ./sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/0.wav \  
  ./sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/1.wav \  
  ./sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/8k.wav
```

It should give you the following output:

```
/Users/runner/work/sherpa-onnx/sherpa-onnx/sherpa-onnx/csrc/offline-stream.  
↳ cc:AcceptWaveformImpl:117 Creating a resampler:  
  in_sample_rate: 8000  
  output_sample_rate: 16000  
-----  
./sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/0.wav  
  after early nightfall the yellow lamps would light up here and there the squalid  
  ↳ quarter of the brothels  
-----  
./sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/1.wav  
  god as a direct consequence of the sin which man thus punished had given her a lovely  
  ↳ child whose place was on that same dishonored bosom to connect her parent for ever  
  ↳ with the race and descent of mortals and to be finally a blessed soul in heaven  
-----  
./sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/8k.wav  
  yet these thoughts affected hester pryne less with hope than apprehension  
-----
```

## 8.11.2 Decode files with streaming models

First, let us build the example:

```
git clone https://github.com/k2-fsa/sherpa-onnx
cd sherpa-onnx/dotnet-examples/online-decode-files
dotnet build -c Release
./bin/Release/net6.0/online-decode-files --help
```

You will find the following output:

```
dotnet run \
  --tokens=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/tokens.txt \
  --encoder=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/encoder-epoch-
  ↵99-avg-1.onnx \
  --decoder=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/decoder-epoch-
  ↵99-avg-1.onnx \
  --joiner=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/joiner-epoch-99-
  ↵avg-1.onnx \
  --num-threads=2 \
  --decoding-method=modified_beam_search \
  --debug=false \
  --files ./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/test_wavs/0.wav \
  ./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/test_wavs/1.wav
```

Please refer to  
[https://k2-fsa.github.io/sherpa/onnx/pretrained\\_models/online-transducer/index.html](https://k2-fsa.github.io/sherpa/onnx/pretrained_models/online-transducer/index.html)  
 to download pre-trained streaming models.

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--tokens	Required. Path to tokens.txt
--provider	(Default: cpu) Provider, e.g., cpu, coreml
--encoder	Required. Path to encoder.onnx
--decoder	Required. Path to decoder.onnx
--joiner	Required. Path to joiner.onnx
--num-threads	(Default: 1) Number of threads for computation
--decoding-method	(Default: greedy_search) Valid decoding methods are: greedy_search, modified_beam_search
--debug	(Default: false) True to show model info during loading
--sample-rate	(Default: 16000) Sample rate of the data used to train the model
--max-active-paths	(Default: 4) Used only when --decoding--method is modified_beam_search. It specifies number of active paths to keep during the search
--enable-endpoint	(Default: false) True to enable endpoint detection.
--rule1-min-trailing-silence	(Default: 2.4) An endpoint is detected if trailing silence in seconds is larger than this value even if nothing has been decoded. Used only when --enable-endpoint

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--rule2-min-trailing-silence	is true. (Default: 1.2) An endpoint is detected if trailing silence in seconds is larger than this value after something that is not blank has been decoded. Used only when --enable-endpoint is true.
--rule3-min-utterance-length	(Default: 20) An endpoint is detected if the utterance in seconds is larger than this value. Used only when --enable-endpoint is true.
--files	Required. Audio files for decoding
--help	Display this help screen.
--version	Display version information.

Now let us refer to *Pre-trained models* to download a streaming model.

We give one example below for demonstration.

## Streaming transducer

We will use *cskuangfj/sherpa-onnx-streaming-zipformer-en-2023-06-26 (English)* as an example.

First, let us download it:

```
cd sherpa-onnx/dotnet-examples/online-decode-files/
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
˓→streaming-zipformer-en-2023-06-26.tar.bz2
tar xvf sherpa-onnx-streaming-zipformer-en-2023-06-26.tar.bz2
rm sherpa-onnx-streaming-zipformer-en-2023-06-26.tar.bz2
```

Now we can use:

```
dotnet run -c Release \
--encoder ./sherpa-onnx-streaming-zipformer-en-2023-06-26/encoder-epoch-99-avg-1-chunk-
˓→16-left-128.onnx \
--decoder ./sherpa-onnx-streaming-zipformer-en-2023-06-26/decoder-epoch-99-avg-1-chunk-
˓→16-left-128.onnx \
--joiner ./sherpa-onnx-streaming-zipformer-en-2023-06-26/joiner-epoch-99-avg-1-chunk-
˓→16-left-128.onnx \
--tokens ./sherpa-onnx-streaming-zipformer-en-2023-06-26/tokens.txt \
--files ./sherpa-onnx-streaming-zipformer-en-2023-06-26/test_wavs/0.wav \
./sherpa-onnx-streaming-zipformer-en-2023-06-26/test_wavs/1.wav \
./sherpa-onnx-streaming-zipformer-en-2023-06-26/test_wavs/8k.wav
```

You will find the following output:

```
/Users/runner/work/sherpa-onnx/sherpa-onnx/sherpa-onnx/csrc/features.
˓→cc:AcceptWaveform:76 Creating a resampler:
  in_sample_rate: 8000
  output_sample_rate: 16000

-----
./sherpa-onnx-streaming-zipformer-en-2023-06-26/test_wavs/0.wav
```

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```

AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID_
↳ QUARTER OF THE BROTHELS
-----
./sherpa-onnx-streaming-zipformer-en-2023-06-26/test_wavs/1.wav
GOD AS A DIRECT CONSEQUENCE OF THE SIN WHICH MAN THUS PUNISHED HAD GIVEN HER A LOVELY_
↳ CHILD WHOSE PLACE WAS ON THAT SAME DISHONORED BOSOM TO CONNECT HER PARENT FOR EVER_
↳ WITH THE RACE AND DESCENT OF MORTALS AND TO BE FINALLY A BLESSED SOUL IN HEAVEN
-----
./sherpa-onnx-streaming-zipformer-en-2023-06-26/test_wavs/8k.wav
YET THESE THOUGHTS AFFECTION HESTER PRYNNE LESS WITH HOPE THAN APPREHENSION
-----
```

### 8.11.3 Real-time speech recognition from microphone

First, let us build the example:

```

git clone https://github.com/k2-fsa/sherpa-onnx
cd sherpa-onnx/dotnet-examples/speech-recognition-from-microphone
dotnet build -c Release
./bin/Release/net6.0/speech-recognition-from-microphone --help
```

You will find the following output:

```

dotnet run -c Release \
  --tokens ./icefall-asr-zipformer-streaming-wenetspeech-20230615/data/lang_char/tokens.
  ↳ txt \
  --encoder ./icefall-asr-zipformer-streaming-wenetspeech-20230615/exp/encoder-epoch-12-
  ↳ avg-4-chunk-16-left-128.onnx \
  --decoder ./icefall-asr-zipformer-streaming-wenetspeech-20230615/exp/decoder-epoch-12-
  ↳ avg-4-chunk-16-left-128.onnx \
  --joiner ./icefall-asr-zipformer-streaming-wenetspeech-20230615/exp/joiner-epoch-12-
  ↳ avg-4-chunk-16-left-128.onnx \
```

Please refer to  
[https://k2-fsa.github.io/sherpa/onnx/pretrained\\_models/online-transducer/index.html](https://k2-fsa.github.io/sherpa/onnx/pretrained_models/online-transducer/index.html)  
 to download pre-trained streaming models.

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--tokens	Required. Path to tokens.txt
--provider	(Default: cpu) Provider, e.g., cpu, coreml
--encoder	Required. Path to encoder.onnx
--decoder	Required. Path to decoder.onnx
--joiner	Required. Path to joiner.onnx
--num-threads	(Default: 1) Number of threads for computation
--decoding-method	(Default: greedy_search) Valid decoding methods are: greedy_search, modified_beam_search
--debug	(Default: false) True to show model info during loading
--sample-rate	(Default: 16000) Sample rate of the data used

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--max-active-paths	to train the model (Default: 4) Used only when --decoding--method is modified_beam_search. It specifies number of active paths to keep during the search
--enable-endpoint	(Default: true) True to enable endpoint detection.
--rule1-min-trailing-silence	(Default: 2.4) An endpoint is detected if trailing silence in seconds is larger than this value even if nothing has been decoded. Used only when --enable-endpoint is true.
--rule2-min-trailing-silence	(Default: 0.8) An endpoint is detected if trailing silence in seconds is larger than this value after something that is not blank has been decoded. Used only when --enable-endpoint is true.
--rule3-min-utterance-length	(Default: 20) An endpoint is detected if the utterance in seconds is larger than this value. Used only when --enable-endpoint is true.
--help	Display this help screen.
--version	Display version information.

Now let us refer to [Pre-trained models](#) to download a streaming model.

We give one example below for demonstration.

## Streaming transducer

We will use [csukuangfj/sherpa-onnx-streaming-zipformer-en-2023-06-26 \(English\)](#) as an example.

First, let us download it:

```
cd sherpa-onnx/dotnet-examples/speech-recognition-from-microphone
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
→streaming-zipformer-en-2023-06-26.tar.bz2
tar xvf sherpa-onnx-streaming-zipformer-en-2023-06-26.tar.bz2
rm sherpa-onnx-streaming-zipformer-en-2023-06-26.tar.bz2
```

Now we can use:

```
dotnet run -c Release \
--encoder ./sherpa-onnx-streaming-zipformer-en-2023-06-26/encoder-epoch-99-avg-1-chunk-
→16-left-128.onnx \
--decoder ./sherpa-onnx-streaming-zipformer-en-2023-06-26/decoder-epoch-99-avg-1-chunk-
→16-left-128.onnx \
--joiner ./sherpa-onnx-streaming-zipformer-en-2023-06-26/joiner-epoch-99-avg-1-chunk-
→16-left-128.onnx \
--tokens ./sherpa-onnx-streaming-zipformer-en-2023-06-26/tokens.txt
```

You will find the following output:

```

PortAudio V19.7.0-devel, revision 147dd722548358763a8b649b3e4b41dfffbcfbb6
Number of devices: 5
Device 0
  Name: Background Music
  Max input channels: 2
  Default sample rate: 44100
Device 1
  Name: Background Music (UI Sounds)
  Max input channels: 2
  Default sample rate: 44100
Device 2
  Name: MacBook Pro Microphone
  Max input channels: 1
  Default sample rate: 48000
Device 3
  Name: MacBook Pro Speakers
  Max input channels: 0
  Default sample rate: 48000
Device 4
  Name: WeMeet Audio Device
  Max input channels: 2
  Default sample rate: 48000

Use default device 2 (MacBook Pro Microphone)
StreamParameters [
  device=2
  channelCount=1
  sampleFormat=Float32
  suggestedLatency=0.03452083333333334
  hostApiSpecificStreamInfo?=[False]
]
Started! Please speak

0: THIS IS A TEST
1: THIS IS A SECOND TEST

```

#### 8.11.4 colab

We provide a colab notebook for you to try the C# API examples of `sherpa-onnx`.

## 8.12 WebAssembly

In this section, we describe how to build `sherpa-onnx` for WebAssembly so that you can run real-time speech recognition with `WebAssembly`.

Please follow the steps below to build and run `sherpa-onnx` for `WebAssembly`.

---

**Hint:** We provide a colab notebook for you to try this section step by step.

If you are using Windows or you don't want to setup your local environment to build WebAssembly support, please

use the above colab notebook.

---

### 8.12.1 Install Emscripten

We need to compile the C/C++ files in `sherpa-onnx` with the help of `emscripten`.

Please refer to [https://emscripten.org/docs/getting\\_started/downloads](https://emscripten.org/docs/getting_started/downloads) for detailed installation instructions.

The following is an example to show you how to install it on Linux/macOS.

```
git clone https://github.com/emscripten-core/emsdk.git
cd emsdk
git pull
./emsdk install latest
./emsdk activate latest
source ./emsdk_env.sh
```

To check that you have installed `emscripten` successfully, please run:

```
emcc -v
```

The above command should print something like below:

```
emcc (Emscripten gcc/clang-like replacement + linker emulating GNU ld) 3.1.48
(e967e20b4727956a30592165a3c1cde5c67fa0a8)
shared:INFO: (Emscripten: Running sanity checks)
(py38) fangjuns-MacBook-Pro:open-source fangjun$ emcc -v
emcc (Emscripten gcc/clang-like replacement + linker emulating GNU ld) 3.1.48
(e967e20b4727956a30592165a3c1cde5c67fa0a8)
clang version 18.0.0 (https://github.com/llvm/llvm-project
(a54545ba6514802178cf7cf1c1dd9f7efbf3cde7)
Target: wasm32-unknown-emscripten
Thread model: posix
InstalledDir: /Users/fangjun/open-source/emsdk/upstream/bin
```

Congratulations! You have successfully installed `emscripten`.

### 8.12.2 Build

After installing `emscripten`, we can build `sherpa-onnx` for WebAssembly now.

Please use the following command to build it:

```
git clone https://github.com/k2-fsa/sherpa-onnx
cd sherpa-onnx

cd wasm/asr/assets

wget -q https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
streaming-zipformer-bilingual-zh-en-2023-02-20.tar.bz2
tar xvf sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20.tar.bz2
rm sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20.tar.bz2
```

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```
# Note it is not an error that we rename encoder.int8.onnx to encoder.onnx

mv sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/encoder-epoch-99-avg-1.
↳ int8.onnx encoder.onnx
mv sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/decoder-epoch-99-avg-1.
↳ onnx decoder.onnx
mv sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/joiner-epoch-99-avg-1.int8.
↳ onnx joiner.onnx
mv sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/tokens.txt ./
rm -rf sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/

cd ../../

./build-wasm-simd-asr.sh
```

**Hint:** You can visit <https://github.com/k2-fsa/sherpa-onnx/releases/tag/asr-models> to download a different model.

If you want to use a streaming Paraformer model, please see <https://github.com/k2-fsa/sherpa-onnx/blob/master/wasm/asr/assets/README.md#paraformer>

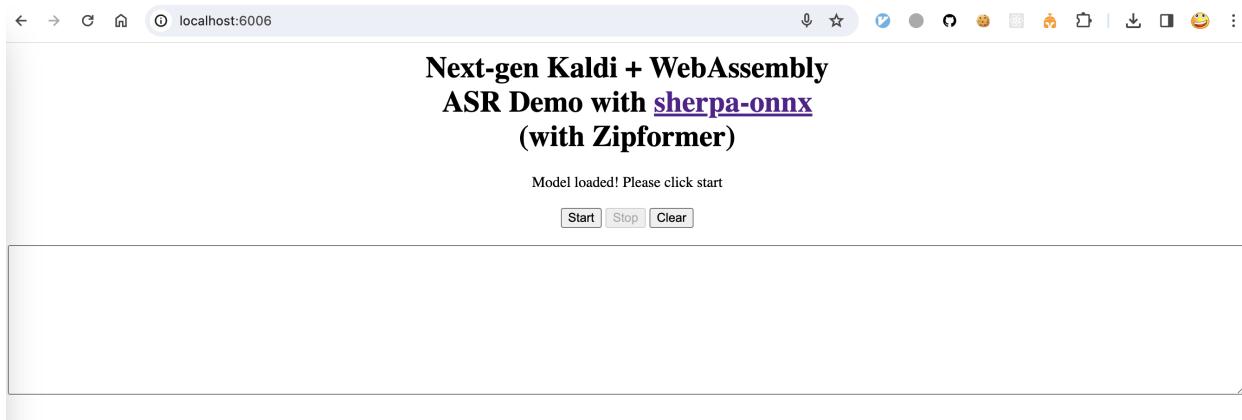
After building, you should see the following output:

```
Install the project...
-- Install configuration: "Release"
-- Installing: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-asr/install/bin/
↳ wasm/asr/sherpa-onnx-wasm-asr-main.js
-- Up-to-date: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-asr/install/bin/
↳ wasm/asr/sherpa-onnx-wasm-asr-main.js
-- Installing: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-asr/install/bin/
↳ wasm/asr/index.html
-- Installing: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-asr/install/bin/
↳ wasm/asr/sherpa-onnx.js
-- Installing: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-asr/install/bin/
↳ wasm/asr/app.js
-- Installing: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-asr/install/bin/
↳ wasm/asr/sherpa-onnx-wasm-asr-main.wasm
-- Installing: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-asr/install/bin/
↳ wasm/asr/sherpa-onnx-wasm-asr-main.data
+ ls -lh install/bin/wasm/asr
total 440080
-rw-r--r-- 1 fangjun staff  9.0K Feb 23 17:39 app.js
-rw-r--r-- 1 fangjun staff 978B Feb 23 17:39 index.html
-rw-r--r-- 1 fangjun staff 199M Feb 23 18:34 sherpa-onnx-wasm-asr-main.data
-rw-r--r-- 1 fangjun staff  90K Feb 23 18:38 sherpa-onnx-wasm-asr-main.js
-rw-r--r-- 1 fangjun staff  10M Feb 23 18:38 sherpa-onnx-wasm-asr-main.wasm
-rw-r--r-- 1 fangjun staff  9.1K Feb 23 17:39 sherpa-onnx.js
```

Now you can use the following command to run it:

```
cd build-wasm-simd-asr/install/bin/wasm/asr
python3 -m http.server 6006
```

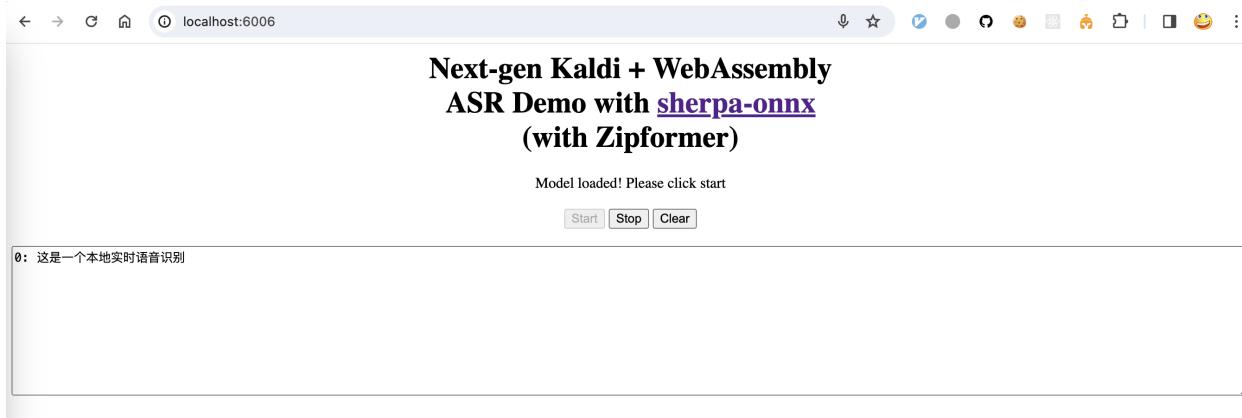
Start your browser and visit <http://localhost:6006>; you should see the following page:



Now click start and speak! You should see the recognition results in the text box.

**Warning:** We are using a bilingual model (Chinese + English) in the above example, which means you can only speak Chinese or English in this case.

A screenshot is given below:



Congratulations! You have successfully run real-time speech recognition with [WebAssembly](#) in your browser.

### 8.12.3 Huggingface Spaces (WebAssembly)

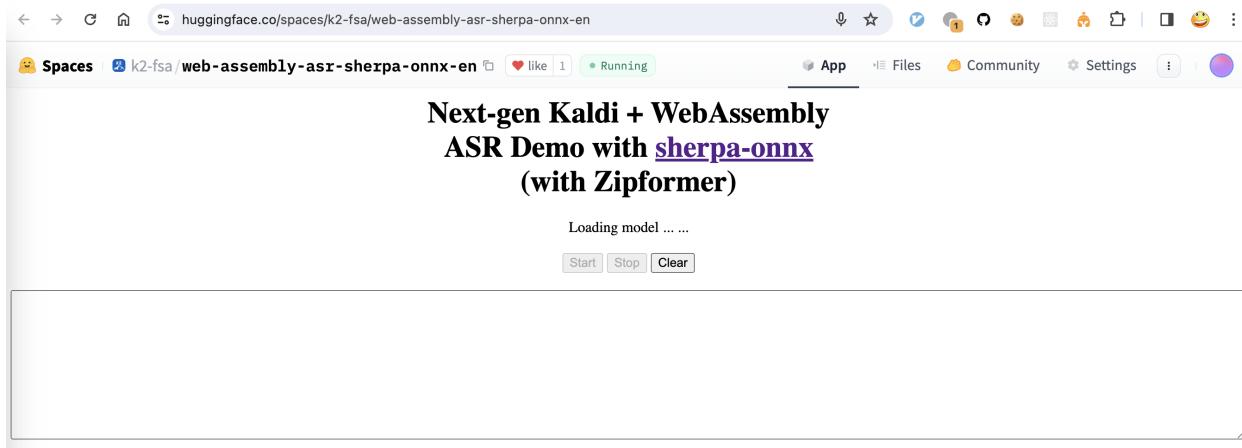
We provide four Huggingface spaces so that you can try real-time speech recognition with WebAssembly in your browser.

#### English only (Zipformer)

<https://huggingface.co/spaces/k2-fsa/web-assembly-asr-sherpa-onnx-en>

**Hint:** If you don't have access to Huggingface, please visit the following mirror:

<https://modelscope.cn/studios/k2-fsa/web-assembly-asr-sherpa-onnx-en/summary>



**Note:** The script for building this space can be found at <https://github.com/k2-fsa/sherpa-onnx/blob/master/.github/workflows/wasm-simd-hf-space-en-asr-zipformer.yaml>

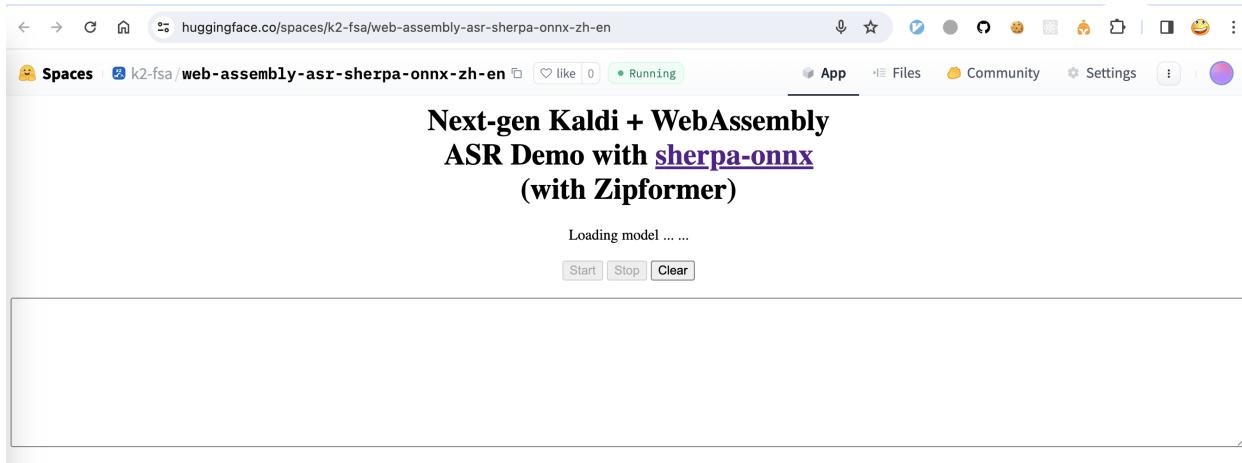
#### Chinese + English (Zipformer)

<https://huggingface.co/spaces/k2-fsa/web-assembly-asr-sherpa-onnx-zh-en>

**Hint:** If you don't have access to Huggingface, please visit the following mirror:

<https://modelscope.cn/studios/k2-fsa/web-assembly-asr-sherpa-onnx-zh-en/summary>

**Note:** The script for building this space can be found at <https://github.com/k2-fsa/sherpa-onnx/blob/master/.github/workflows/wasm-simd-hf-space-zh-en-asr-zipformer.yaml>



### Chinese + English (Paraformer)

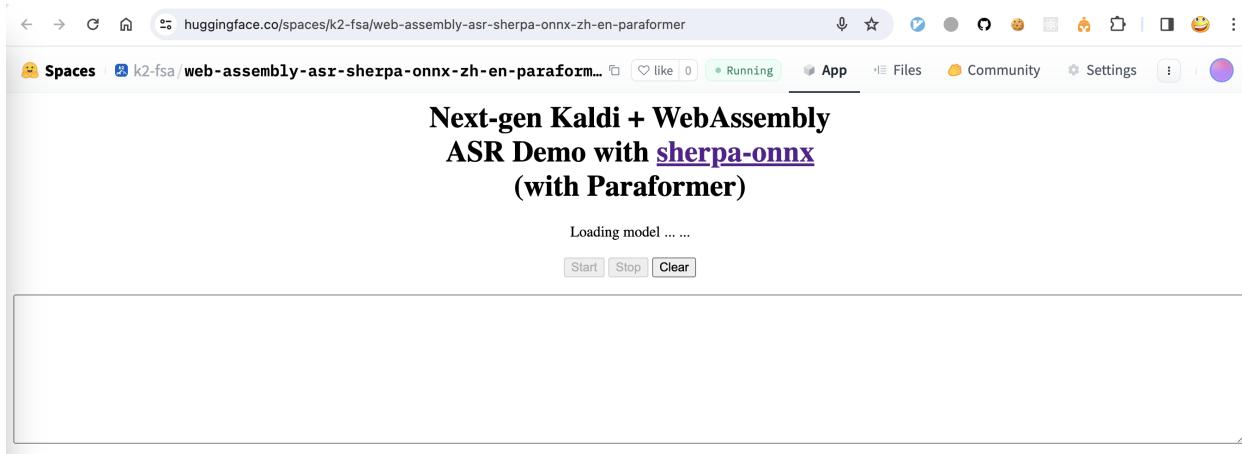
<https://huggingface.co/spaces/k2-fsa/web-assembly-asr-sherpa-onnx-zh-en-paraformer>

---

**Hint:** If you don't have access to Huggingface, please visit the following mirror:

<https://modelscope.cn/studios/k2-fsa/web-assembly-asr-sherpa-onnx-zh-en-paraformer/summary>

---



---

**Note:** The script for building this space can be found at <https://github.com/k2-fsa/sherpa-onnx/blob/master/.github/workflows/wasm-simd-hf-space-zh-en-asr-paraformer.yaml>

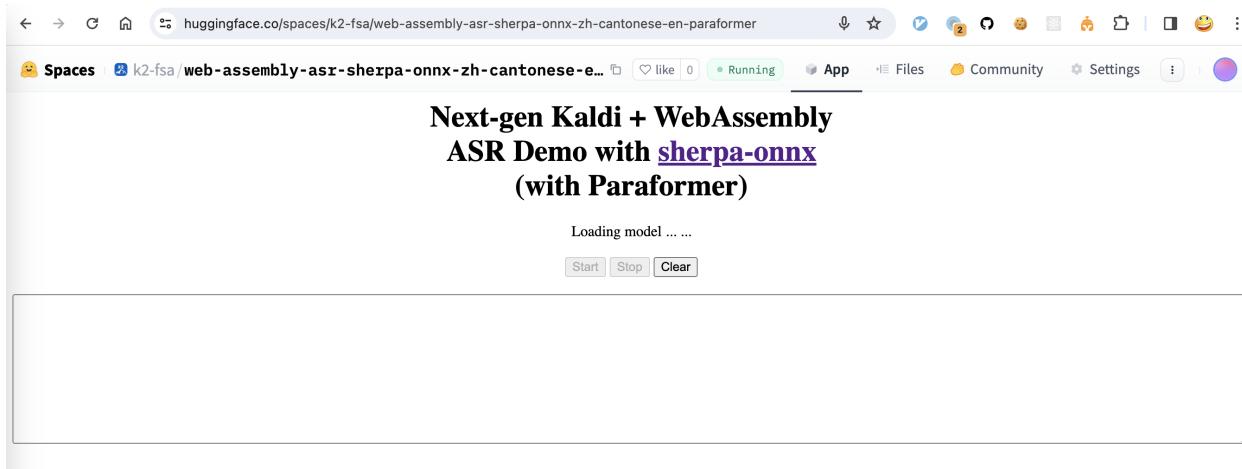
---

## Chinese + English + Cantonese (Paraformer)

<https://huggingface.co/spaces/k2-fsa/web-assembly-asr-sherpa-onnx-zh-cantonese-en-paraformer>

**Hint:** If you don't have access to Huggingface, please visit the following mirror:

<https://modelscope.cn/studios/k2-fsa/web-assembly-asr-sherpa-onnx-zh-cantonese-en-paraformer/summary>



**Note:** The script for building this space can be found at <https://github.com/k2-fsa/sherpa-onnx/blob/master/.github/workflows/wasm-simd-hf-space-zh-cantonese-en-asr-paraformer.yaml>

## 8.13 Android

In this section, we describe how to build an Android app for **real-time** speech recognition with `sherpa-onnx`.

**Hint:** During speech recognition, it does not need to access the Internet. Everything is processed locally on your phone.

### 8.13.1 Pre-built APKs

Links for pre-built APKs can be found in the following table:

**Hint:** It runs locally, without internet connection.

	URL
Streaming speech recognition	<a href="https://k2-fsa.github.io/sherpa/onnx/android/apk.html">https://k2-fsa.github.io/sherpa/onnx/android/apk.html</a>
Text-to-speech engine	<a href="https://k2-fsa.github.io/sherpa/onnx/tts/apk-engine.html">https://k2-fsa.github.io/sherpa/onnx/tts/apk-engine.html</a>
Voice activity detection (VAD)	<a href="https://k2-fsa.github.io/sherpa/onnx/vad/apk.html">https://k2-fsa.github.io/sherpa/onnx/vad/apk.html</a>
VAD + non-streaming speech recognition	<a href="https://k2-fsa.github.io/sherpa/onnx/vad/apk-asr.html">https://k2-fsa.github.io/sherpa/onnx/vad/apk-asr.html</a>
Two-pass speech recognition	<a href="https://k2-fsa.github.io/sherpa/onnx/android/apk-2pass.html">https://k2-fsa.github.io/sherpa/onnx/android/apk-2pass.html</a>
Audio tagging	<a href="https://k2-fsa.github.io/sherpa/onnx/audio-tagging/apk.html">https://k2-fsa.github.io/sherpa/onnx/audio-tagging/apk.html</a>
Audio tagging (WearOS)	<a href="https://k2-fsa.github.io/sherpa/onnx/audio-tagging/apk-wearos.html">https://k2-fsa.github.io/sherpa/onnx/audio-tagging/apk-wearos.html</a>
Speaker identification	<a href="https://k2-fsa.github.io/sherpa/onnx/speaker-identification/apk.html">https://k2-fsa.github.io/sherpa/onnx/speaker-identification/apk.html</a>
Spoken language identification	<a href="https://k2-fsa.github.io/sherpa/onnx/spoken-language-identification/apk.html">https://k2-fsa.github.io/sherpa/onnx/spoken-language-identification/apk.html</a>
Keyword spotting	<a href="https://k2-fsa.github.io/sherpa/onnx/kws/apk.html">https://k2-fsa.github.io/sherpa/onnx/kws/apk.html</a>

### 8.13.2 Build sherpa-onnx for Android

You can use this section for both **speech-to-text** (STT, ASR) and **text-to-speech** (TTS).

---

**Hint:** The build scripts mentioned in this section run on both Linux and macOS.

If you are using Windows or if you don't want to build the shared libraries, you can download pre-built shared libraries by visiting the release page <https://github.com/k2-fsa/sherpa-onnx/releases/>

For instance, for the release v1.9.14, you can visit <https://github.com/k2-fsa/sherpa-onnx/releases/tag/v1.9.14> and download the file `sherpa-onnx-v1.9.14-android.tar.bz2` using the following command:

```
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/v1.9.14/sherpa-  
-onnx-v1.9.14-android.tar.bz2
```

---

Please always use the latest release.

---

**Hint:** This section is originally written for speech-to-text. However, it is also applicable to other folders in <https://github.com/k2-fsa/sherpa-onnx/tree/master/android>.

For instance, you can replace `SherpaOnnx` in this section with

- `SherpaOnnx2Pass`
- `SherpaOnnxTts` (this is for text-to-speech)
- `SherpaOnnxTtsEngine` (this is for text-to-speech)
- `SherpaOnnxVad`
- `SherpaOnnxVadAsr`
- `SherpaOnnxSpeakerIdentification`
- `SherpaOnnxAudioTagging`
- `SherpaOnnxAudioTaggingWearOs`

## Install Android Studio

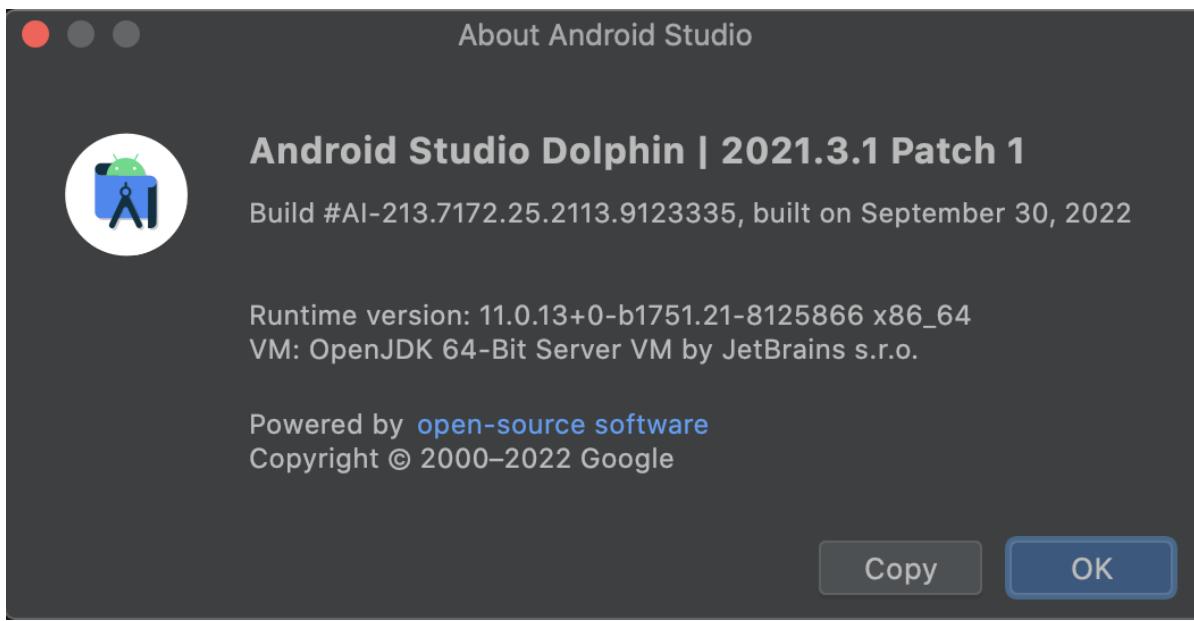
The first step is to download and install Android Studio.

Please refer to <https://developer.android.com/studio> for how to install Android Studio.

---

**Hint:** Any recent version of Android Studio should work fine. Also, you can use the default settings of Android Studio during installation.

For reference, we post the version we are using below:



---

## Download sherpa-onnx

Next, download the source code of sherpa-onnx:

```
git clone https://github.com/k2-fsa/sherpa-onnx
```

## Install NDK

Step 1, start Android Studio.

Step 2, Open `sherpa-onnx/android/SherpaOnnx`.

Step 3, Select Tools -> SDK Manager.

Step 4, Install NDK.

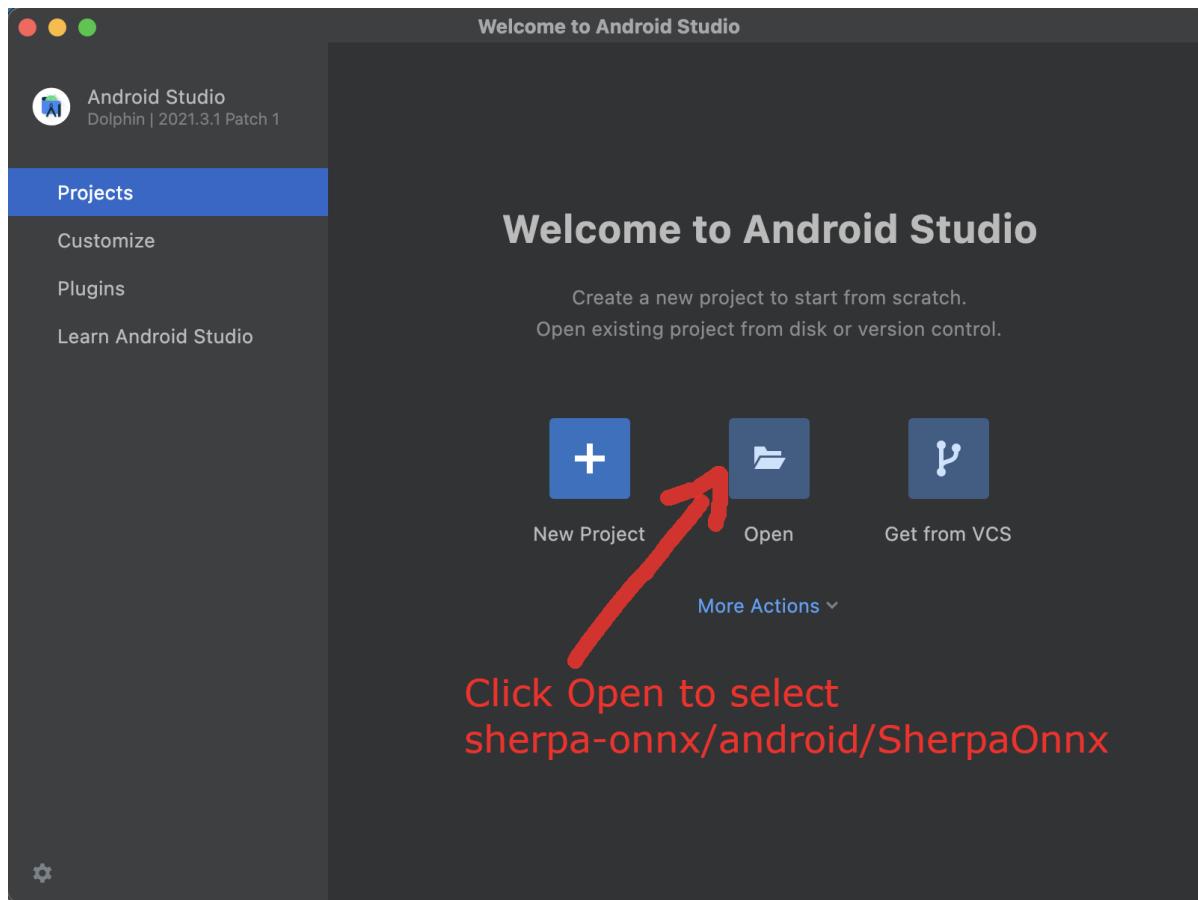


Fig. 8.1: Step 1: Click Open to select sherpa-onnx/android/SherpaOnnx

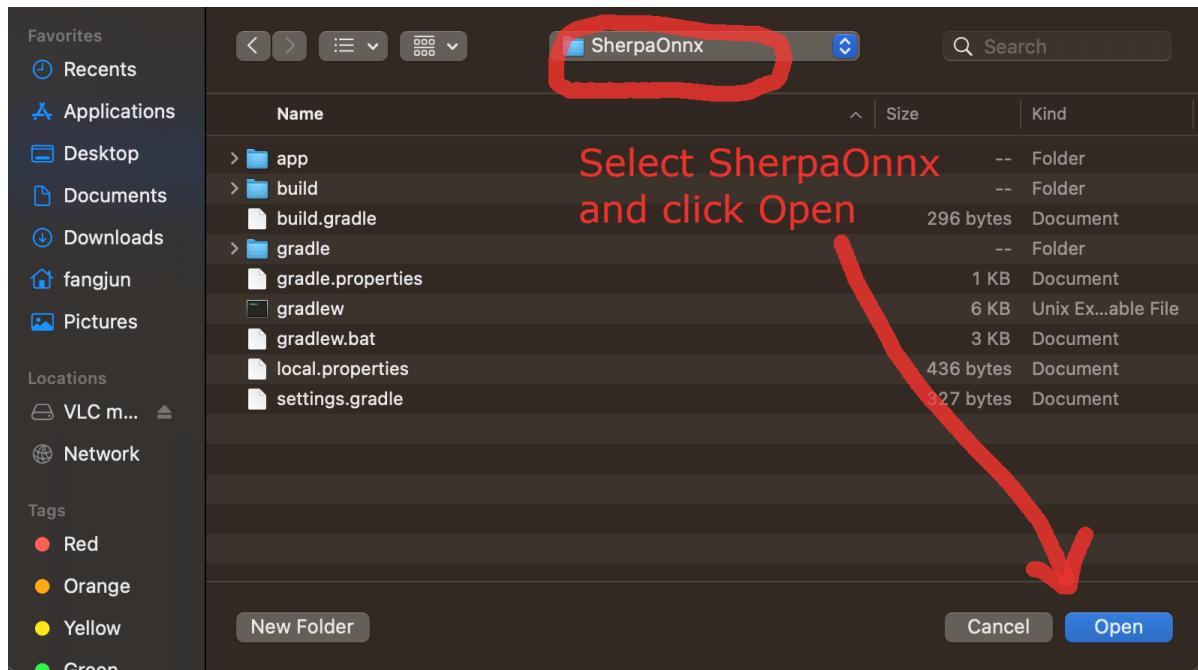


Fig. 8.2: Step 2: Open SherpaOnnx.

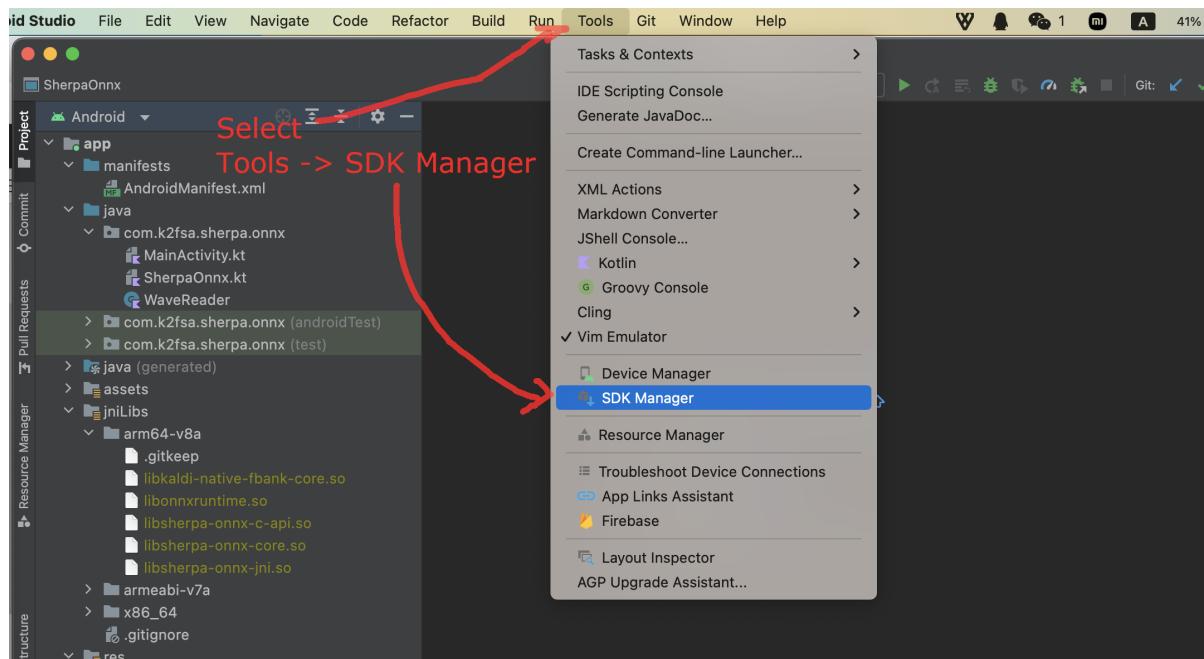


Fig. 8.3: Step 3: Select Tools -&gt; SDK Manager.

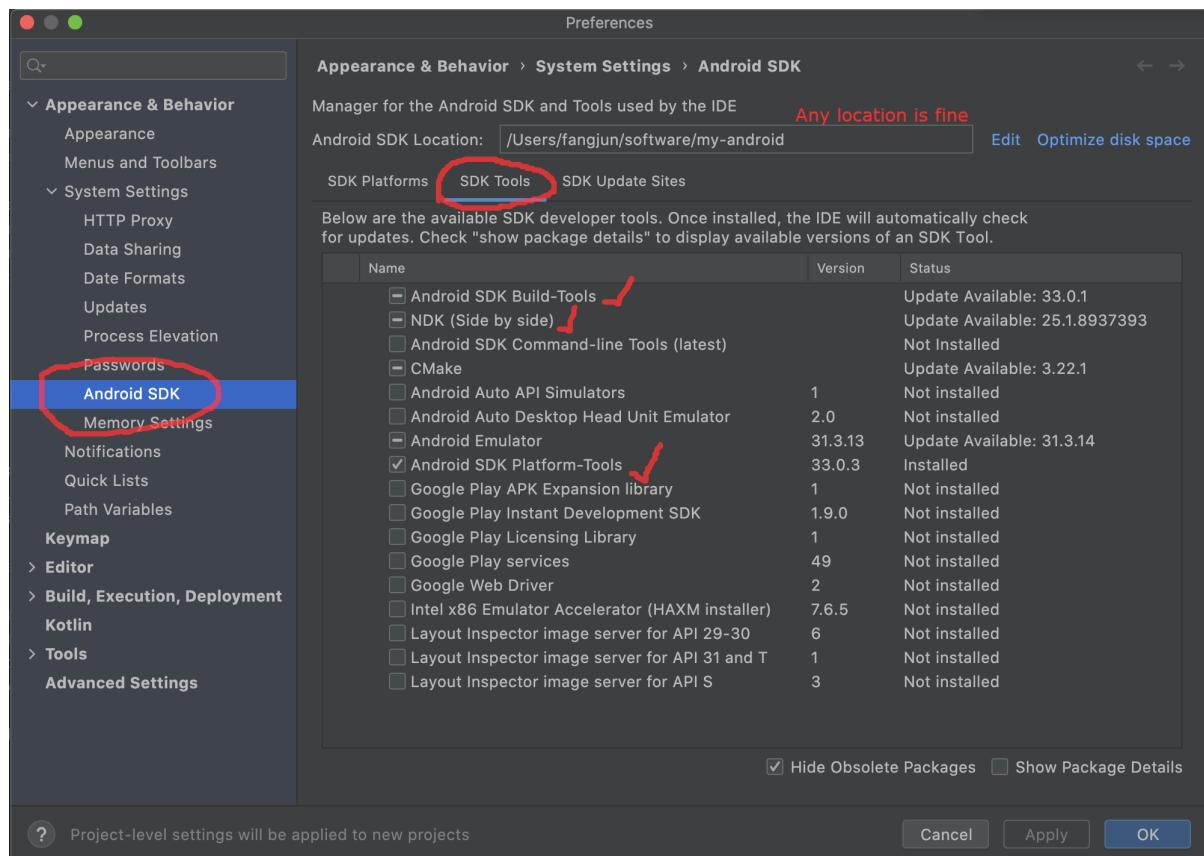


Fig. 8.4: Step 4: Install NDK.

In the following, we assume Android SDK location was set to `/Users/fangjun/software/my-android`. You can change it accordingly below.

After installing NDK, you can find it in

```
/Users/fangjun/software/my-android/ndk/22.1.7171670
```

**Warning:** If you selected a different version of NDK, please replace `22.1.7171670` accordingly.

Next, let us set the environment variable `ANDROID_NDK` for later use.

```
export ANDROID_NDK=/Users/fangjun/software/my-android/ndk/22.1.7171670
```

---

**Note:** Note from <https://github.com/Tencent/ncnn/wiki/how-to-build#build-for-android>

(Important) remove the hardcoded debug flag in Android NDK to fix the android-ndk issue: <https://github.com/android/ndk/issues/243>

1. open `$ANDROID_NDK/build/cmake/android.toolchain.cmake` for `ndk < r23` or `$ANDROID_NDK/build/cmake/android-legacy.toolchain.cmake` for `ndk >= r23`

2. delete the line containing “-g”

```
list(APPEND ANDROID_COMPILER_FLAGS
  -g
  -DANDROID
```

---

### Build sherpa-onnx (C++ code)

After installing NDK, it is time to build the C++ code of `sherpa-onnx`.

In the following, we show how to build `sherpa-onnx` for the following Android ABIs:

- `arm64-v8a`
- `armv7-eabi`
- `x86_64`
- `x86`

**Caution:** You only need to select one and only one ABI. `arm64-v8a` is probably the most common one.

If you want to test the app on an emulator, you probably need `x86_64`.

---

**Hint:** Building scripts for this section are for macOS and Linux. If you are using Windows or if you don't want to build the shared libraries by yourself, you can download pre-compiled shared libraries for this section by visiting

<https://github.com/k2-fsa/sherpa-onnx/releases>

---

**Hint:** We provide a colab notebook for you to try this section step by step.

If you are using Windows or you don't want to setup your local environment to build the C++ libraries, please use the above colab notebook.

## Build for arm64-v8a

```
cd sherpa-onnx # Go to the root repo
./build-android-arm64-v8a.sh
```

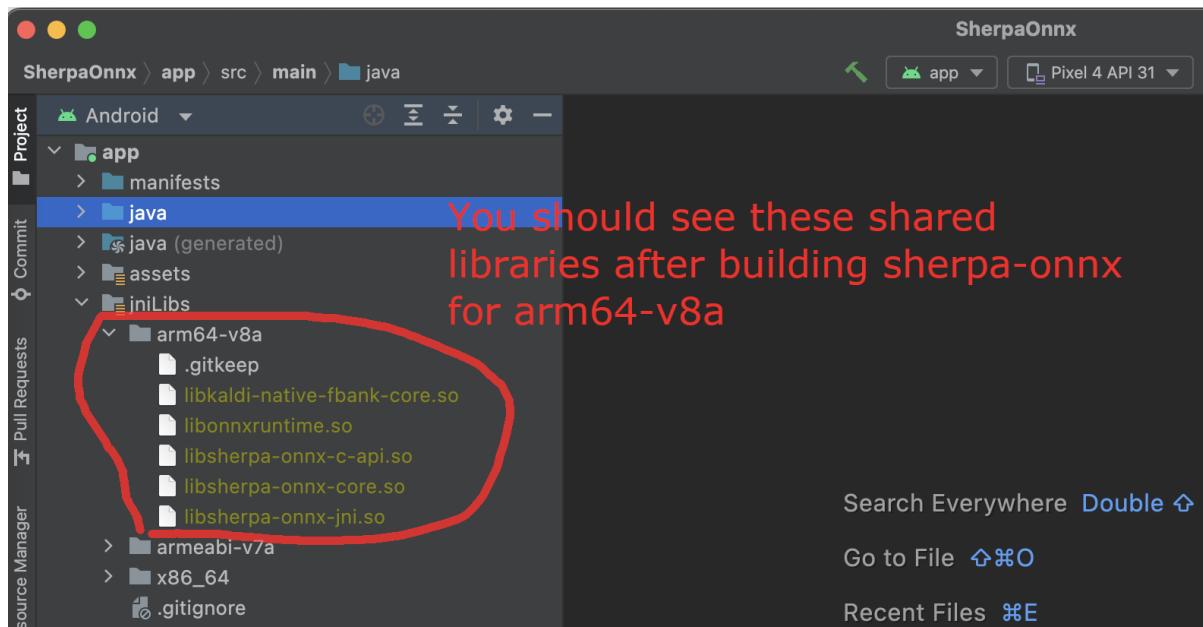
After building, you will find the following shared libraries:

```
ls -lh build-android-arm64-v8a/install/lib/lib*.so
-rwxr-xr-x 1 fangjun staff 848K Feb 26 15:54 build-android-arm64-v8a/install/lib/
libkaldi-native-fbank-core.so
-rw-r--r--@ 1 fangjun staff 13M Feb 26 15:54 build-android-arm64-v8a/install/lib/
libonnxruntime.so
-rwxr-xr-x 1 fangjun staff 29K Feb 26 15:54 build-android-arm64-v8a/install/lib/
libsherpa-onnx-c-api.so
-rwxr-xr-x 1 fangjun staff 313K Feb 26 15:54 build-android-arm64-v8a/install/lib/
libsherpa-onnx-core.so
-rwxr-xr-x 1 fangjun staff 34K Feb 26 15:54 build-android-arm64-v8a/install/lib/
libsherpa-onnx-jni.so
```

Please copy them to android/SherpaOnnx/app/src/main/jniLibs/arm64-v8a/:

```
cp build-android-arm64-v8a/install/lib/lib*.so android/SherpaOnnx/app/src/main/jniLibs/
arm64-v8a/
```

You should see the following screen shot after running the above copy cp command.



**Hint:** You may see more files than it is shown in the screenshot. That is totally fine since we are extending `sherpa-onnx`.

The first thing to remember is to always use the wildcard `lib*.so` in the `cp` command.

### Build for armv7-eabi

```
cd sherpa-onnx # Go to the root repo
./build-android-armv7-eabi.sh
```

After building, you will find the following shared libraries:

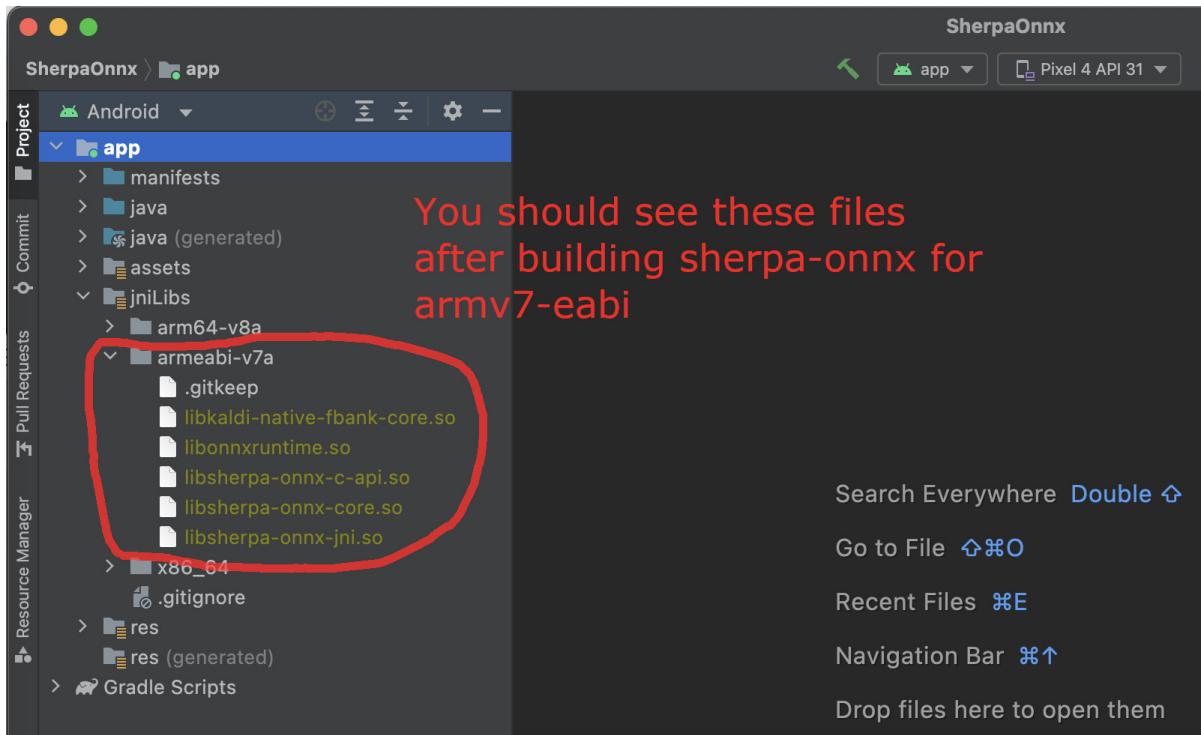
```
ls -lh build-android-armv7-eabi/install/lib/lib*.so

-rwxr-xr-x 1 fangjun staff 513K Mar 4 21:48 build-android-armv7-eabi/install/lib/
libkaldi-native-fbank-core.so
-rw-r--r-- 1 fangjun staff 9.1M Mar 4 21:48 build-android-armv7-eabi/install/lib/
libonnxruntime.so
-rwxr-xr-x 1 fangjun staff 19K Mar 4 21:48 build-android-armv7-eabi/install/lib/
libsherpa-onnx-c-api.so
-rwxr-xr-x 1 fangjun staff 298K Mar 4 21:48 build-android-armv7-eabi/install/lib/
libsherpa-onnx-core.so
-rwxr-xr-x 1 fangjun staff 22K Mar 4 21:48 build-android-armv7-eabi/install/lib/
libsherpa-onnx-jni.so
```

Please copy them to `android/SherpaOnnx/app/src/main/jniLibs/armeabi-v7a`:

```
cp build-android-armv7-eabi/install/lib/lib*.so android/SherpaOnnx/app/src/main/jniLibs/
armeabi-v7a/
```

You should see the following screen shot after running the above copy `cp` command.



## Build for x86\_64

```
cd sherpa-onnx # Go to the root repo
./build-android-x86-64.sh
```

After building, you will find the following shared libraries:

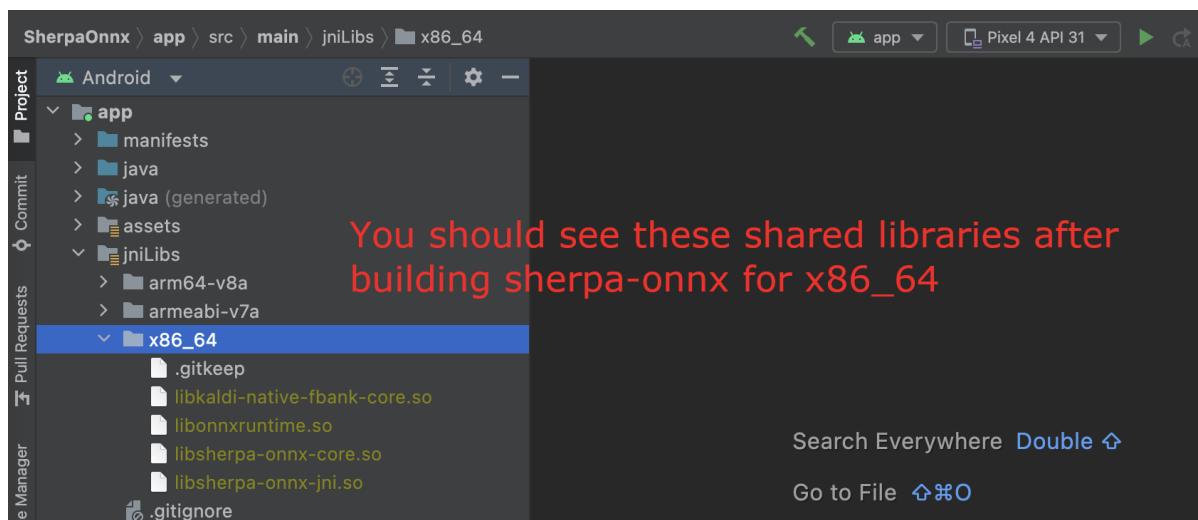
```
ls -lh build-android-x86-64/install/lib/lib*.so

-rwxr-xr-x 1 fangjun staff 901K Feb 26 16:00 build-android-x86-64/install/lib/
libkaldi-native-fbank-core.so
-rw-r--r--@ 1 fangjun staff 15M Feb 26 16:00 build-android-x86-64/install/lib/
libonnxruntime.so
-rwxr-xr-x 1 fangjun staff 347K Feb 26 16:00 build-android-x86-64/install/lib/
libsherpa-onnx-core.so
-rwxr-xr-x 1 fangjun staff 32K Feb 26 16:00 build-android-x86-64/install/lib/
libsherpa-onnx-jni.so
```

Please copy them to android/SherpaOnnx/app/src/main/jniLibs/x86\_64/:

```
build-android-x86-64/install/lib/lib*.so android/SherpaOnnx/app/src/main/jniLibs/x86_64/
```

You should see the following screen shot after running the above copy cp command.



## Build for x86

```
cd sherpa-onnx # Go to the root repo
./build-android-x86.sh
```

## Download pre-trained models

Please read [Pre-trained models](#) for all available pre-trained models.

In the following, we use a pre-trained model [csukuangfj/sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20](https://huggingface.co/csukuangfj/sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20) (*Bilingual, Chinese + English*), which supports both Chinese and English.

---

**Hint:** The model is trained using `icefall` and the original torchscript model is from <https://huggingface.co/pfluo/k2fsa-zipformer-chinese-english-mixed>.

---

Use the following command to download the pre-trained model and place it into `android/SherpaOnnx/app/src/main/assets/`:

```
cd android/SherpaOnnx/app/src/main/assets/  
  
sudo apt-get install git-lfs  
  
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-  
→streaming-zipformer-bilingual-zh-en-2023-02-20.tar.bz2  
  
tar xvf sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20.tar.bz2  
rm sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20.tar.bz2  
  
cd sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20  
  
# Now, remove extra files to reduce the file size of the generated apk  
rm -rf .git test_wavs  
rm -f *.sh README.md
```

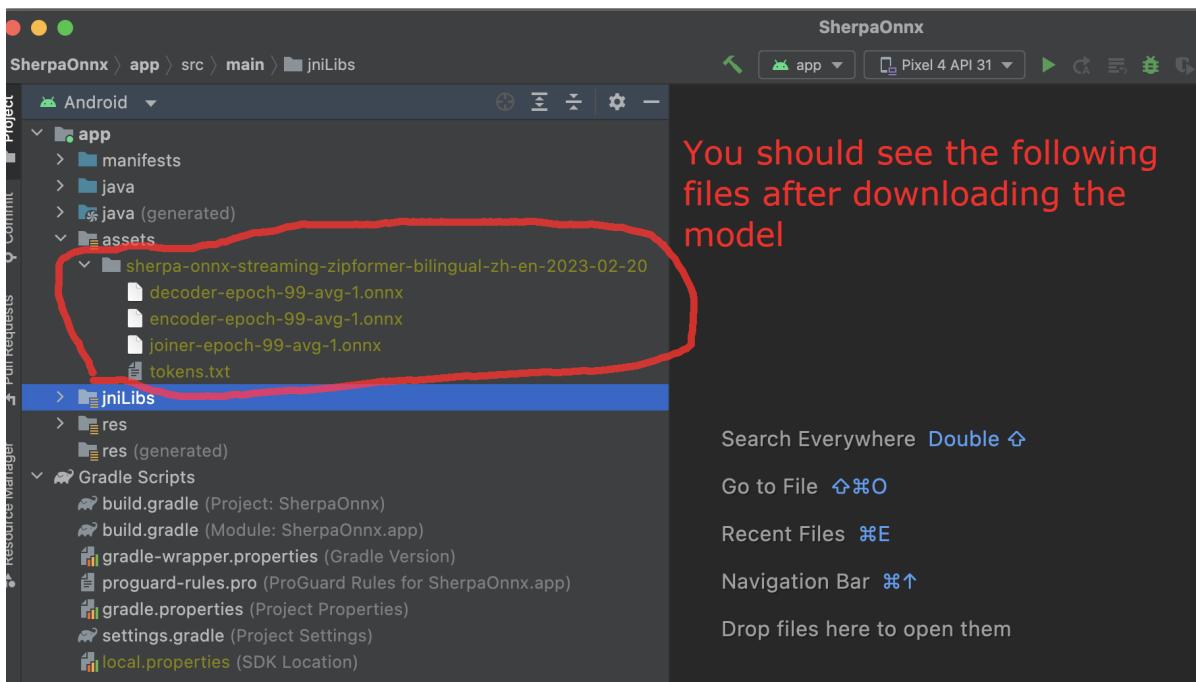
In the end, you should have the following files:

```
ls -lh  
  
total 696984  
-rw-r--r-- 1 fangjun staff 13M Feb 21 21:45 decoder-epoch-99-avg-1.onnx  
-rw-r--r-- 1 fangjun staff 315M Feb 23 21:18 encoder-epoch-99-avg-1.onnx  
-rw-r--r-- 1 fangjun staff 12M Feb 21 21:45 joiner-epoch-99-avg-1.onnx  
-rw-r--r-- 1 fangjun staff 55K Feb 21 21:45 tokens.txt  
  
du -h .  
  
340M .
```

You should see the following screen shot after downloading the pre-trained model:

---

**Hint:** If you select a different pre-trained model, make sure that you also change the corresponding code listed in the following screen shot:



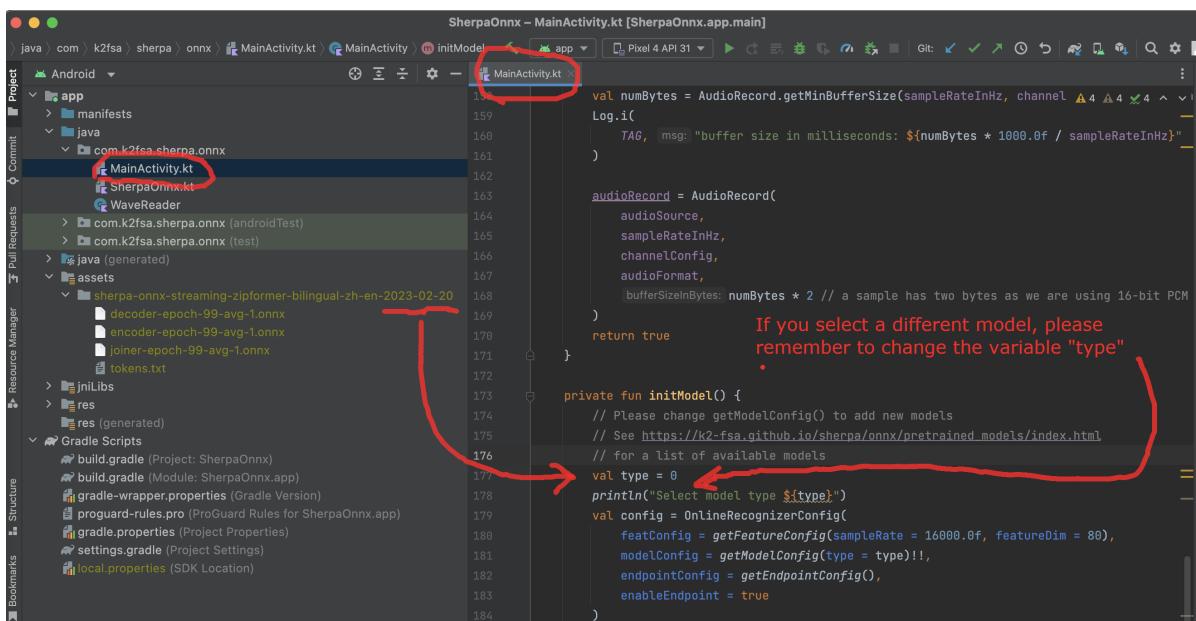
Search Everywhere Double ⌘

Go to File ⌘⌘O

Recent Files ⌘E

Navigation Bar ⌘↑

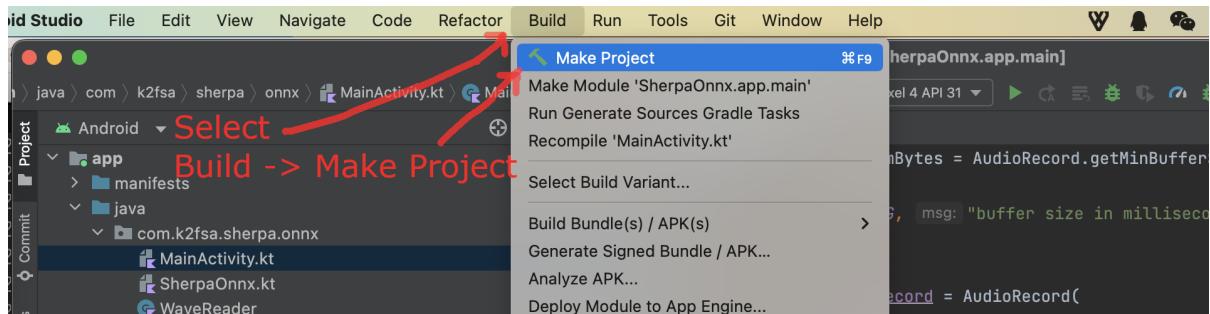
Drop files here to open them



### Generate APK

Finally, it is time to build `sherpa-onnx` to generate an APK package.

Select Build -> Make Project, as shown in the following screen shot.



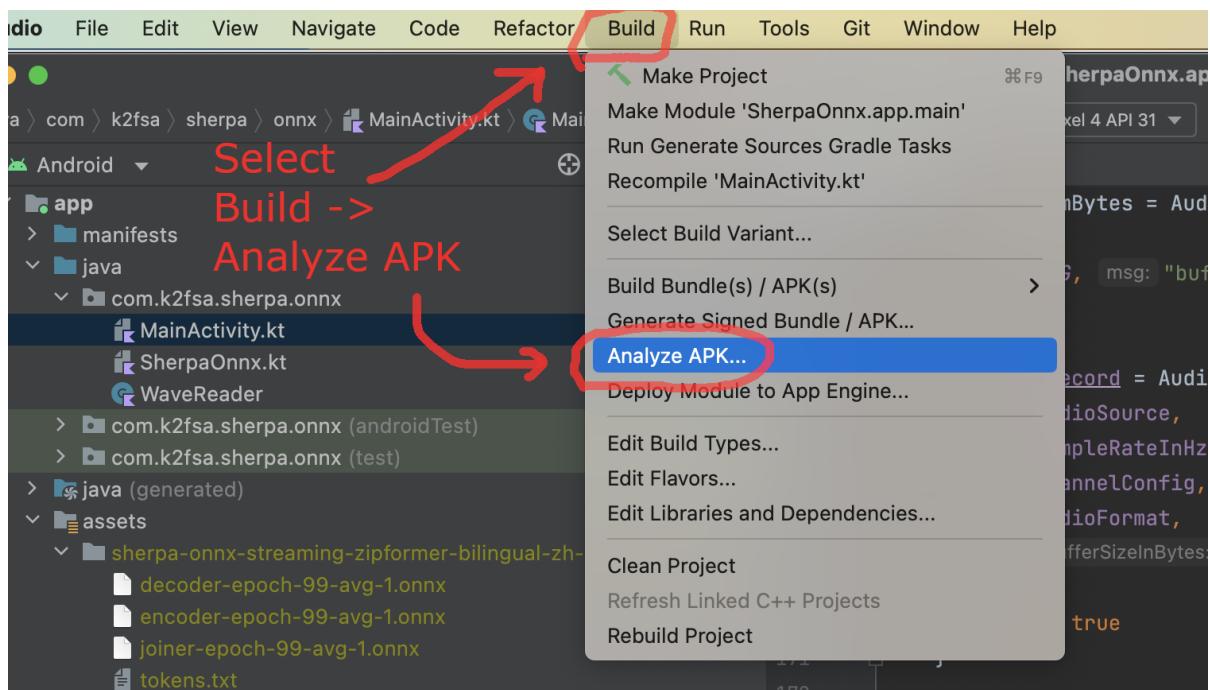
You can find the generated APK in `android/SherpaOnnx/app/build/outputs/apk/debug/app-debug.apk`:

```
ls -lh android/SherpaOnnx/app/build/outputs/apk/debug/app-debug.apk
-rw-r--r-- 1 fangjun staff 331M Feb 26 16:17 android/SherpaOnnx/app/build/outputs/
apk/debug/app-debug.apk
```

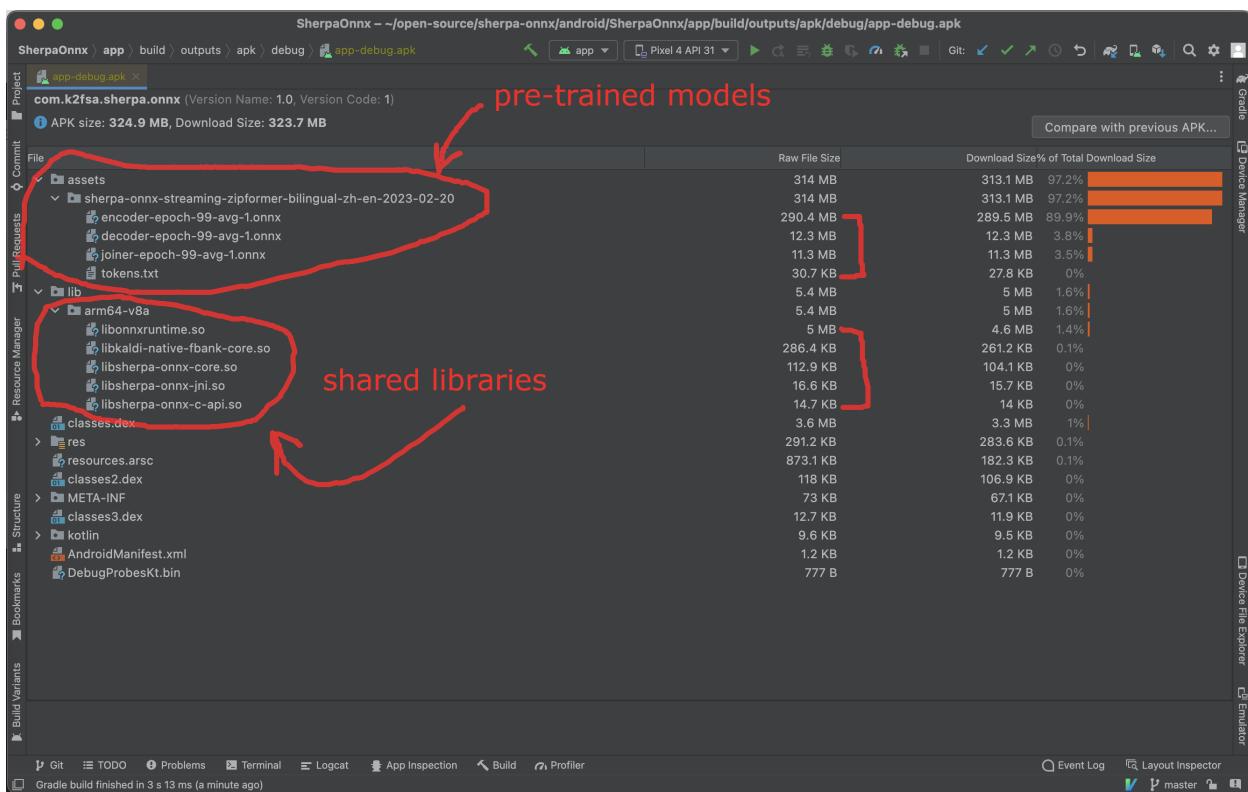
Congratulations! You have successfully built an APK for Android.

Read below to learn more.

### Analyze the APK



Select Build -> Analyze APK ... in the above screen shot, in the popped-up dialog select the generated APK `app-debug.apk`, and you will see the following screen shot:



You can see from the above screen shot that most part of the APK is occupied by the pre-trained model, while the runtime, including the shared libraries, is only 5.4 MB.

**Caution:** You can see that `libonnxruntime.so` alone occupies 5MB out of 5.4MB.

We use a so-called `Full build` instead of `Mobile build`, so the file size of the library is somewhat a bit larger.

`libonnxruntime.so` is downloaded from

<https://mvnrepository.com/artifact/com.microsoft.onnxruntime/onnxruntime-android/1.14.0>

Please refer to <https://onnxruntime.ai/docs/build/custom.html> for a custom build to reduce the file size of `libonnxruntime.so`.

Note that we are constantly updating the version of `onnxruntime`. By the time you are reading this section, we may be using the latest version of `onnxruntime`.

**Hint:** We recommend you to use `sherpa-ncnn`. Please see *Analyze the APK* for `sherpa-ncnn`. The total runtime of `sherpa-ncnn` is only 1.6 MB, which is much smaller than `sherpa-onnx`.

## 8.14 iOS

In this section, we describe how to build an iOS app for `real-time` speech recognition with `sherpa-onnx` and run it within a simulator on your Mac, run it on you iPhone or iPad.

---

**Hint:** During speech recognition, it does not need to access the Internet. Everyting is processed locally on your device.

---

### 8.14.1 Build `sherpa-onnx` for iOS

This section describes how to build `sherpa-onnx` for iPhone and iPad.

#### Requirement

**Warning:** The minimum deployment requires the iOS version `>= 13.0`.

Before we continue, please make sure the following requirements are satisfied:

- macOS. It won't work on Windows or Linux.
- Xcode. The version 14.2 (14C18) is known to work. Other versions may also work.
- CMake. CMake 3.25.1 is known to work. Other versions may also work.
- (Optional) iPhone or iPad. This is for testing the app on your device. If you don't have a device, you can still run the app within a simulator on your Mac.

#### Caution:

If you get the following error:

```
CMake Error at toolchains/ios.toolchain.cmake:544 (get_filename_component):  
  get_filename_component called with incorrect number of arguments  
Call Stack (most recent call first):  
  /usr/local/Cellar/cmake/3.29.0/share/cmake/Modules/CMakeDetermineSystem.  
  ↗cmake:146 (include)  
  CMakeLists.txt:2 (project)
```

please run:

```
sudo xcode-select --install  
sudo xcodebuild -license
```

And then delete the build directory `./build-ios` and re-build.

Please see also <https://github.com/k2-fsa/sherpa-onnx/issues/702>.

## Download sherpa-onnx

First, let us download the source code of `sherpa-onnx`.

---

**Note:** In the following, I will download `sherpa-onnx` to `$HOME/open-source`, i.e., `/Users/fangjun/open-source`, on my Mac.

You can put it anywhere as you like.

---

```
mkdir -p $HOME/open-source
cd $HOME/open-source
git clone https://github.com/k2-fsa/sherpa-onnx
```

## Build sherpa-onnx (in commandline, C++ Part)

After downloading `sherpa-onnx`, let us build the C++ part of `sherpa-onnx`.

```
cd $HOME/open-source/sherpa-onnx/
./build-ios.sh
```

It will generate a directory `$HOME/open-source/sherpa-onnx/build-ios`, which we have already pre-configured for you in Xcode.

## Build sherpa-onnx (in Xcode)

Use the following command to open `sherpa-onnx` in Xcode:

```
cd $HOME/open-source/sherpa-onnx/ios-swift/SherpaOnnx
open SherpaOnnx.xcodeproj
```

It will start Xcode and you will see the following screenshot:

Please select `Product -> Build` to build the project. See the screenshot below:

After finishing the build, you should see the following screenshot:

Congratulations! You have successfully built the project. Let us run the project by selecting `Product -> Run`, which is shown in the following screenshot:

Please wait for a few seconds before Xcode starts the simulator.

Unfortunately, it will throw the following error:

The reason for the above error is that we have not provided the pre-trained model yet.

The file `ViewController.swift` pre-selects the pre-trained model to be `csukuangfj/sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20 (Bilingual, Chinese + English)`, shown in the screenshot below:

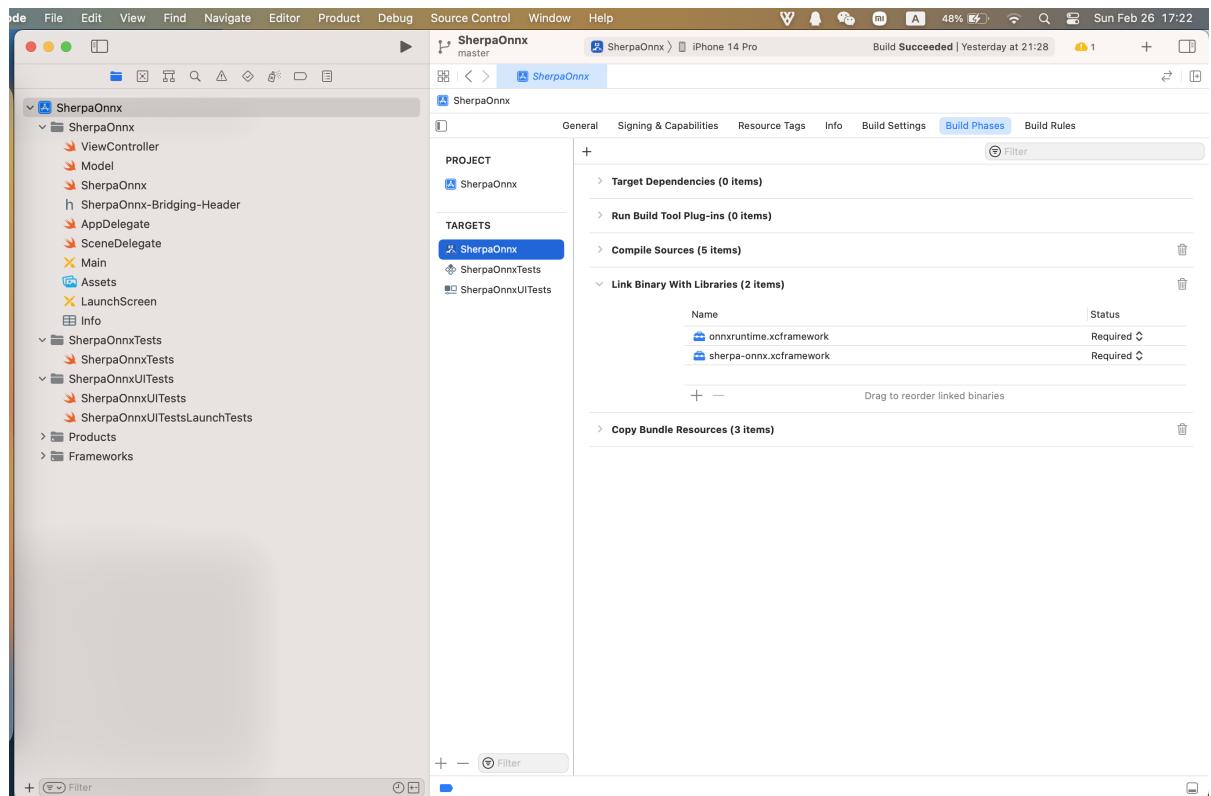


Fig. 8.5: Screenshot after running the command `open SherpaOnnx.xcodeproj`

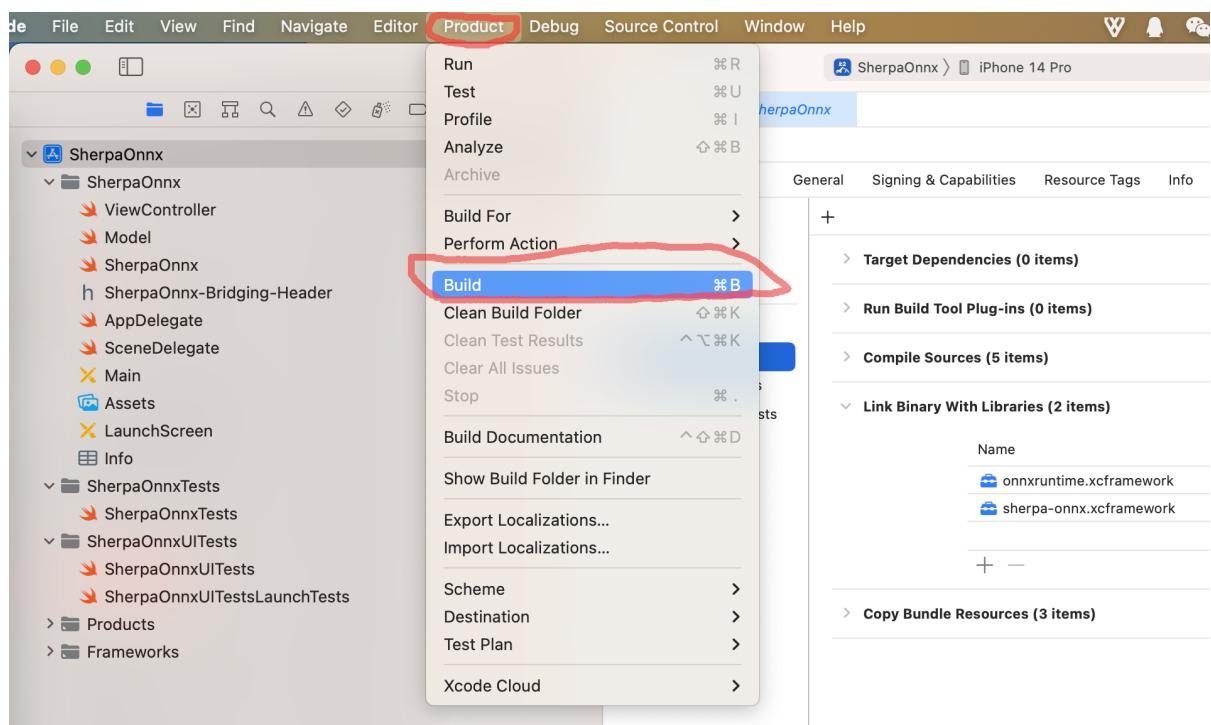


Fig. 8.6: Screenshot for selecting Product -> Build



Fig. 8.7: Screenshot after finishing the build.

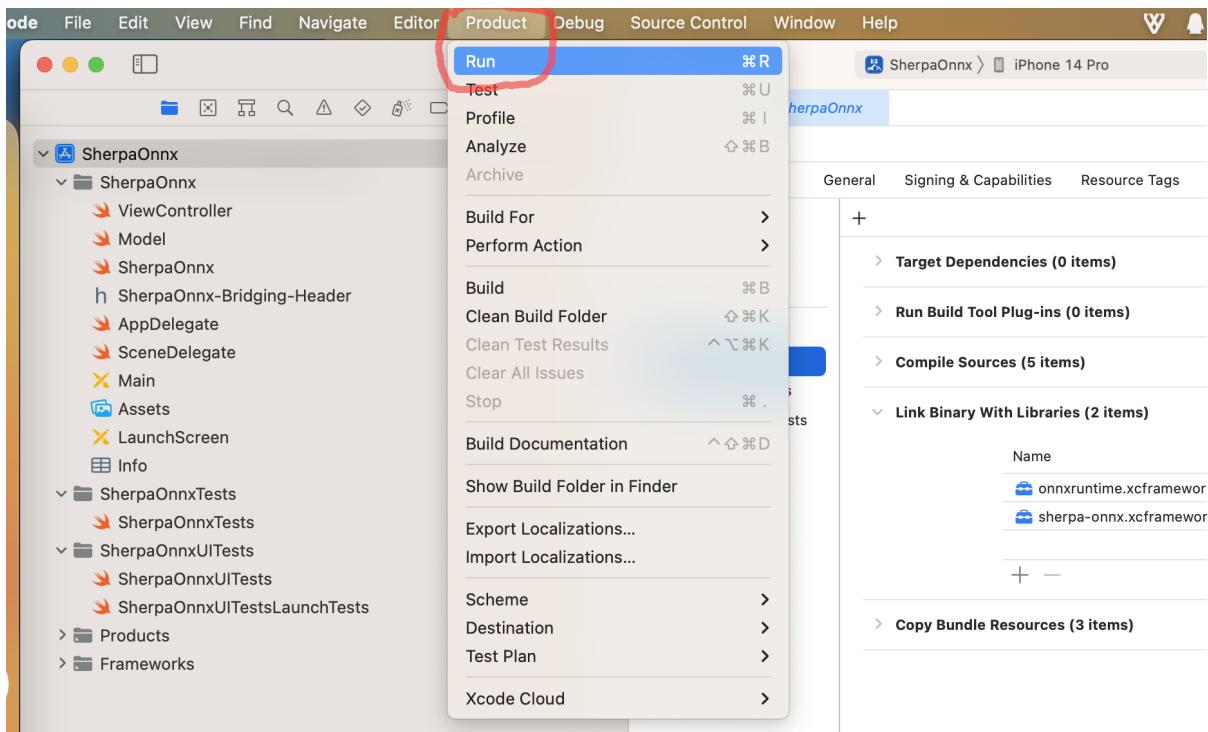


Fig. 8.8: Screenshot for Product -&gt; Run.

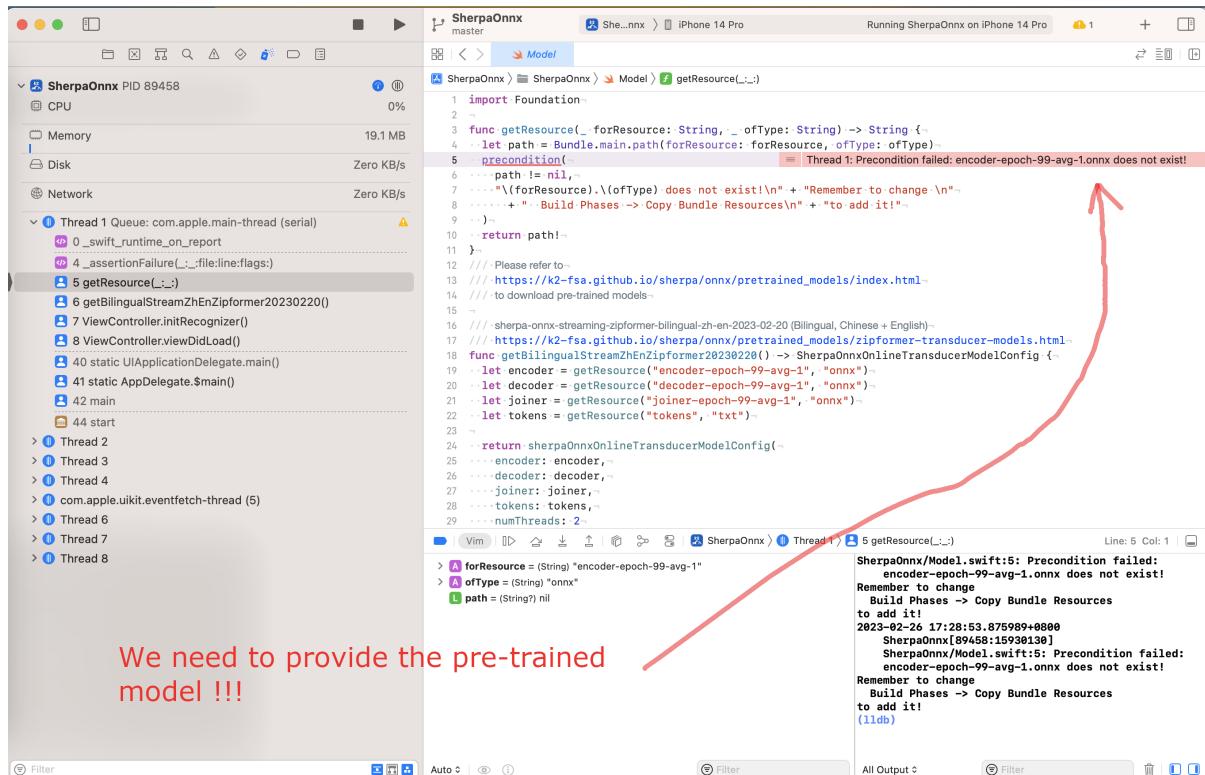


Fig. 8.9: Screenshot for the error

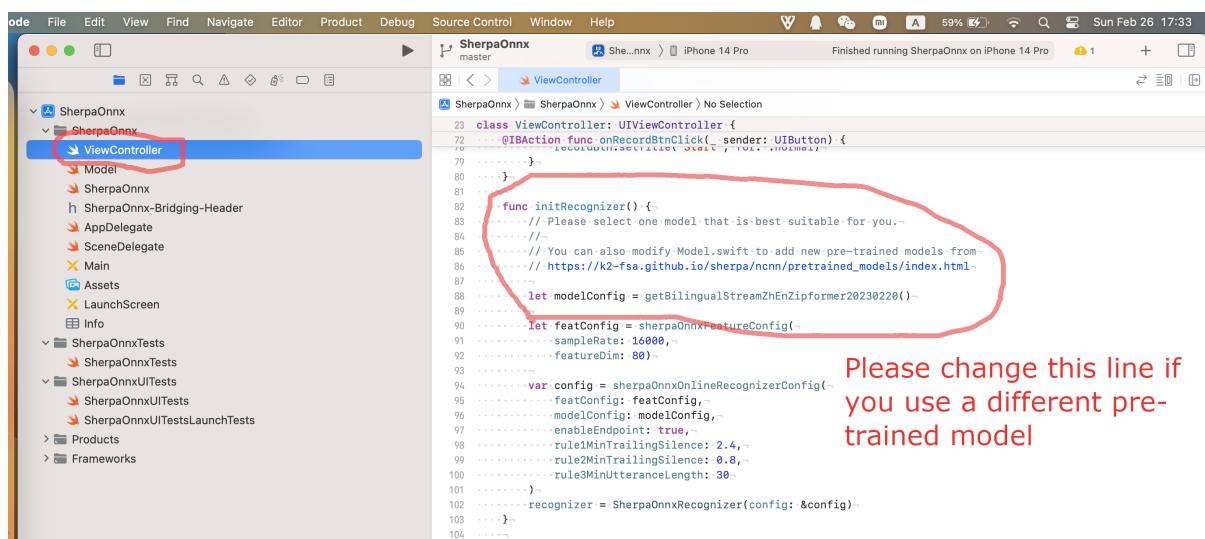


Fig. 8.10: Screenshot for the pre-selected pre-trained model

Let us add the pre-trained model [csukuangfj/sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20](https://huggingface.co/csukuangfj/sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20) (*Bilingual, Chinese + English*) to Xcode. Please follow [csukuangfj/sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20](https://huggingface.co/csukuangfj/sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20) (*Bilingual, Chinese + English*) to download it from huggingface. You can download it to any directory as you like.

Please right click the project SherpaOnnx and select **Add Files to "SherpaOnnx"...** in the popup menu, as is shown in the screenshot below:

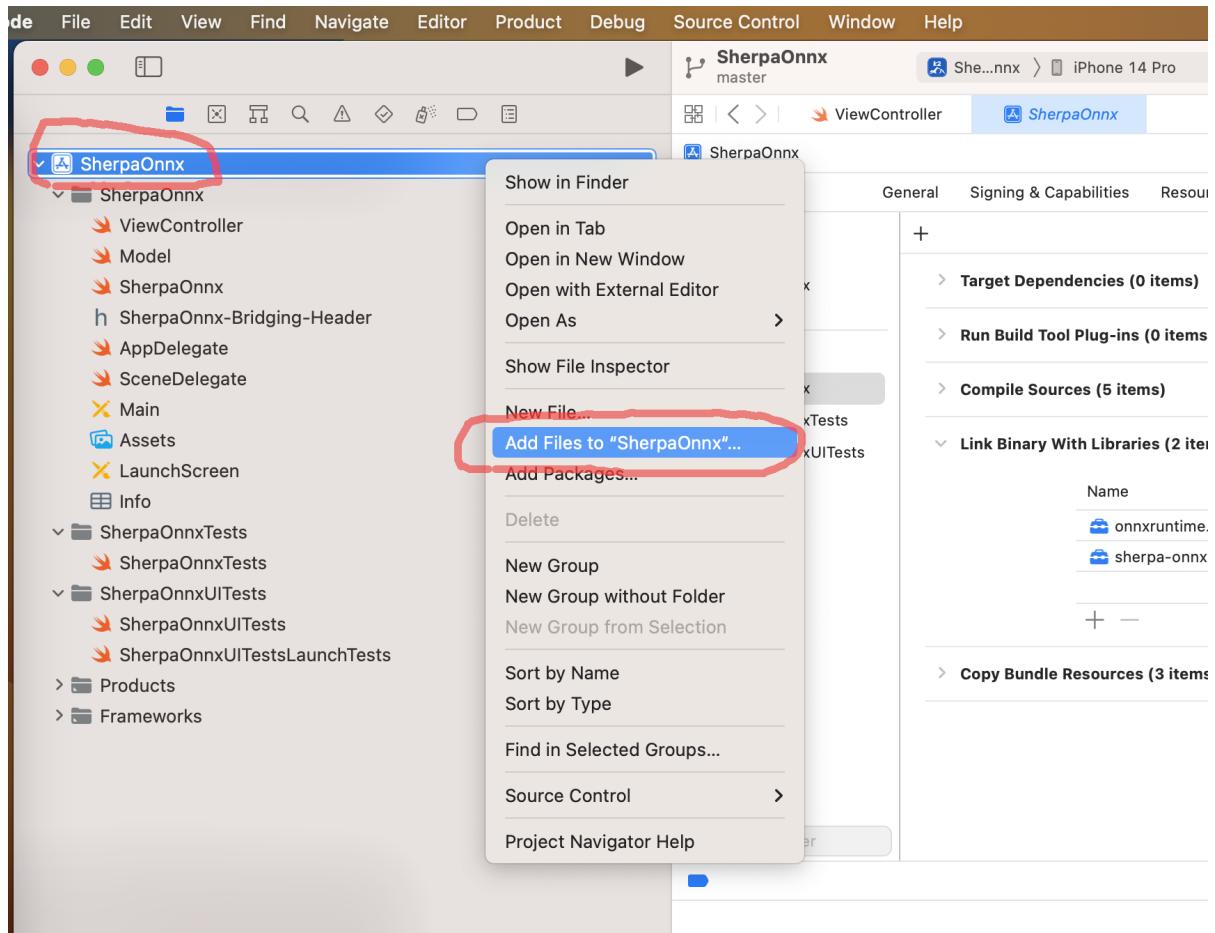


Fig. 8.11: Screenshot for adding files to SherpaOnnx

In the popup dialog, switch to the folder where you just downloaded the pre-trained model.

In the screenshot below, it is the folder `/Users/fangjun/open-source/icefall-models/sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20`:

Select required files and click the button **Add**:

After adding pre-trained model files to Xcode, you should see the following screenshot:

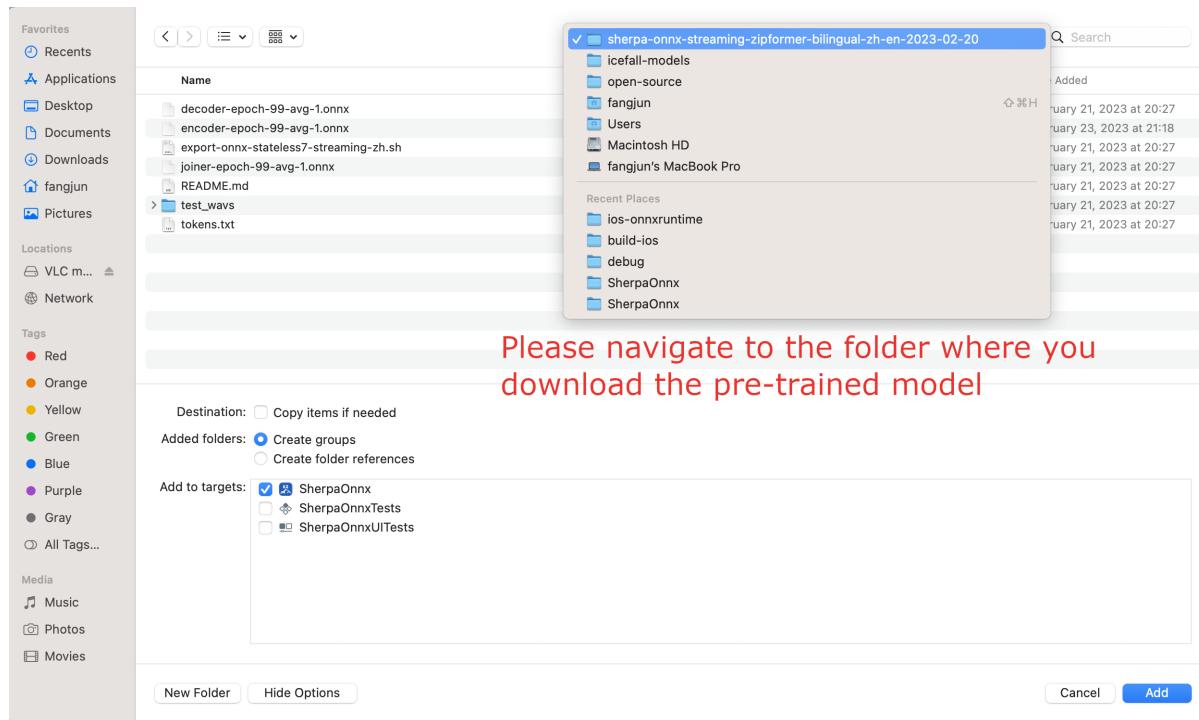


Fig. 8.12: Screenshot for navigating to the folder containing the downloaded pre-trained

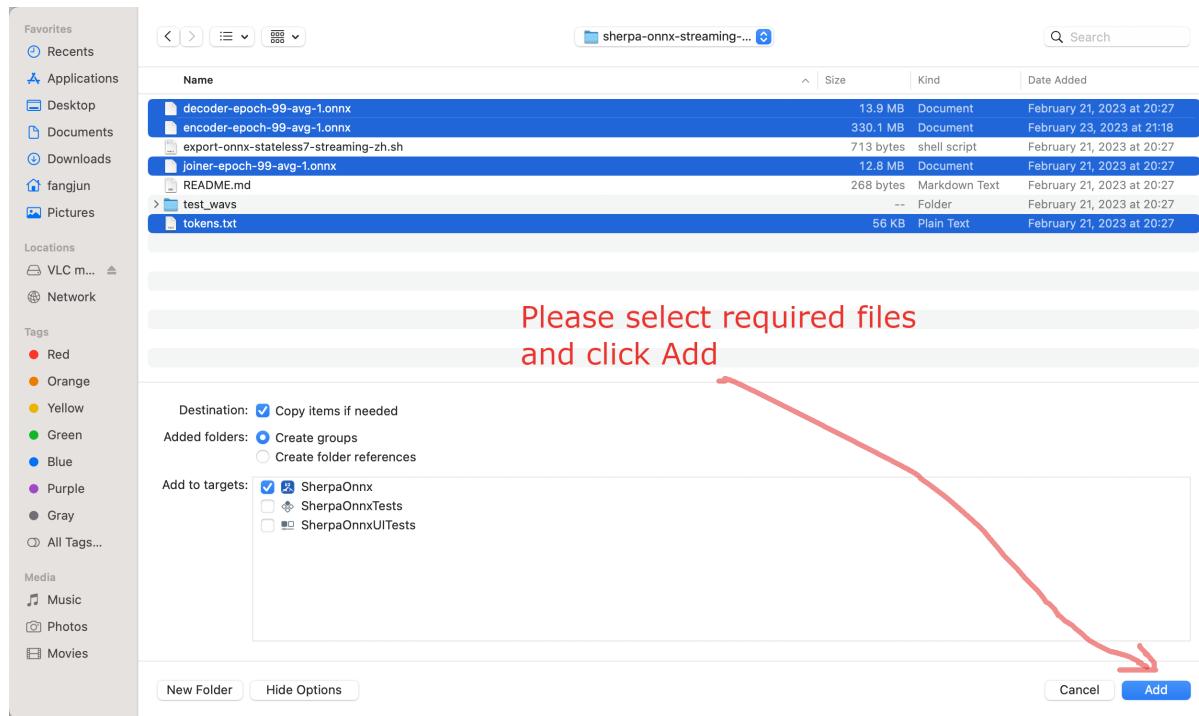


Fig. 8.13: Screenshot for selecting required files

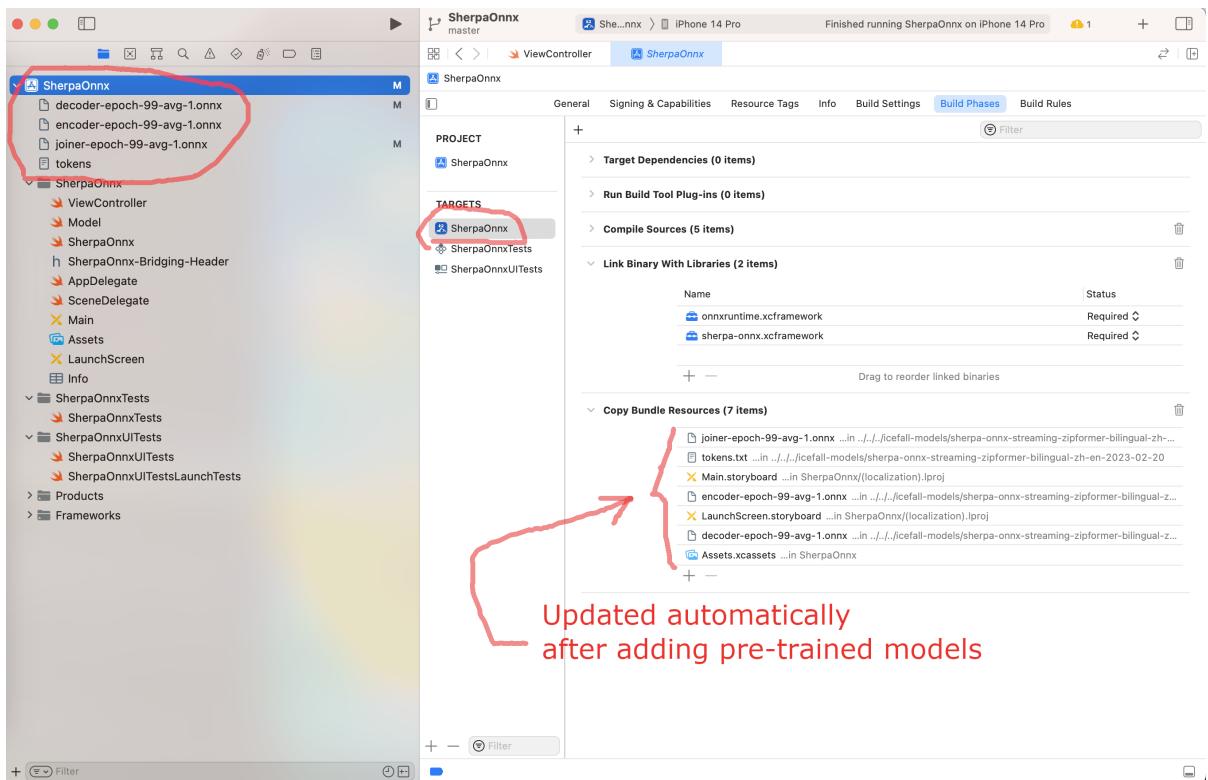


Fig. 8.14: Screenshot after add pre-trained model files

At this point, you should be able to select the menu **Product** -> **Run** to run the project and you should finally see the following screenshot:

Click the button to start recording! A screenshot is given below:

Congratulations! You have finally succeeded in running `sherpa-onnx` with iOS, though it is in a simulator.

Please read below if you want to run `sherpa-onnx` on your iPhone or iPad.

### Run `sherpa-onnx` on your iPhone/iPad

First, please make sure the iOS version of your iPhone/iPad is  $\geq 13.0$ .

Click the menu **Xcode** -> **Settings...**, as is shown in the following screenshot:

In the popup dialog, please select **Account** and click **+** to add your Apple ID, as is shown in the following screenshots.

After adding your Apple ID, please connect your iPhone or iPad to your Mac and select your device in Xcode. The following screenshot is an example to select my iPhone.

Now your Xcode should look like below after selecting a device:

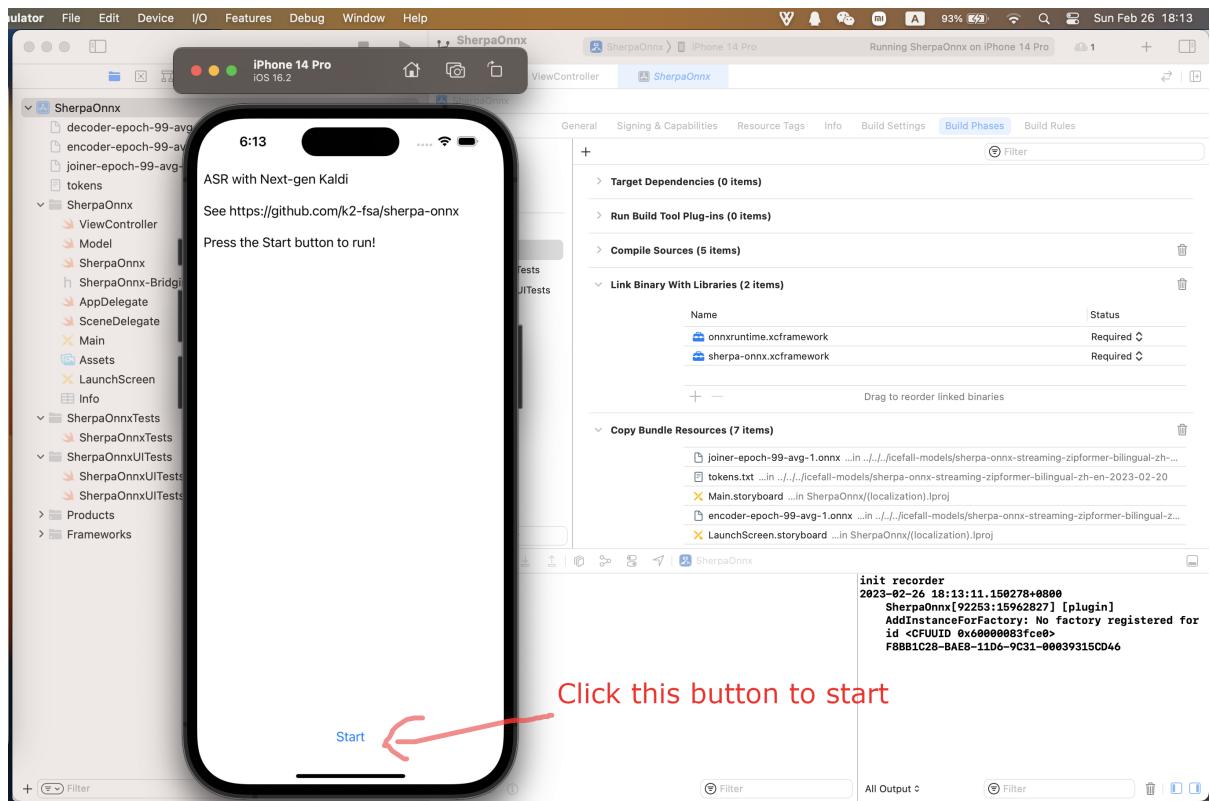


Fig. 8.15: Screenshot for a successful run.

Please select Product → Run again to run `sherpa-onnx` on your selected device, as is shown in the following screenshot:

After a successful build, check your iPhone/iPad and you should see the following screenshot:

At this point, you should be able to run the app on your device. The following is a screenshot about running it on my iPhone:

Congratulations! You have successfully run `sherpa-onnx` on your device!

## 8.15 WebSocket

In this section, we describe how to use the `WebSocket` server and client for real-time speech recognition with `sherpa-onnx`.

The `WebSocket` server is implemented in C++ with the help of `websocketpp` and `asio`.

**Hint:** It does not depend on `boost`.

It does not depend on `boost`.

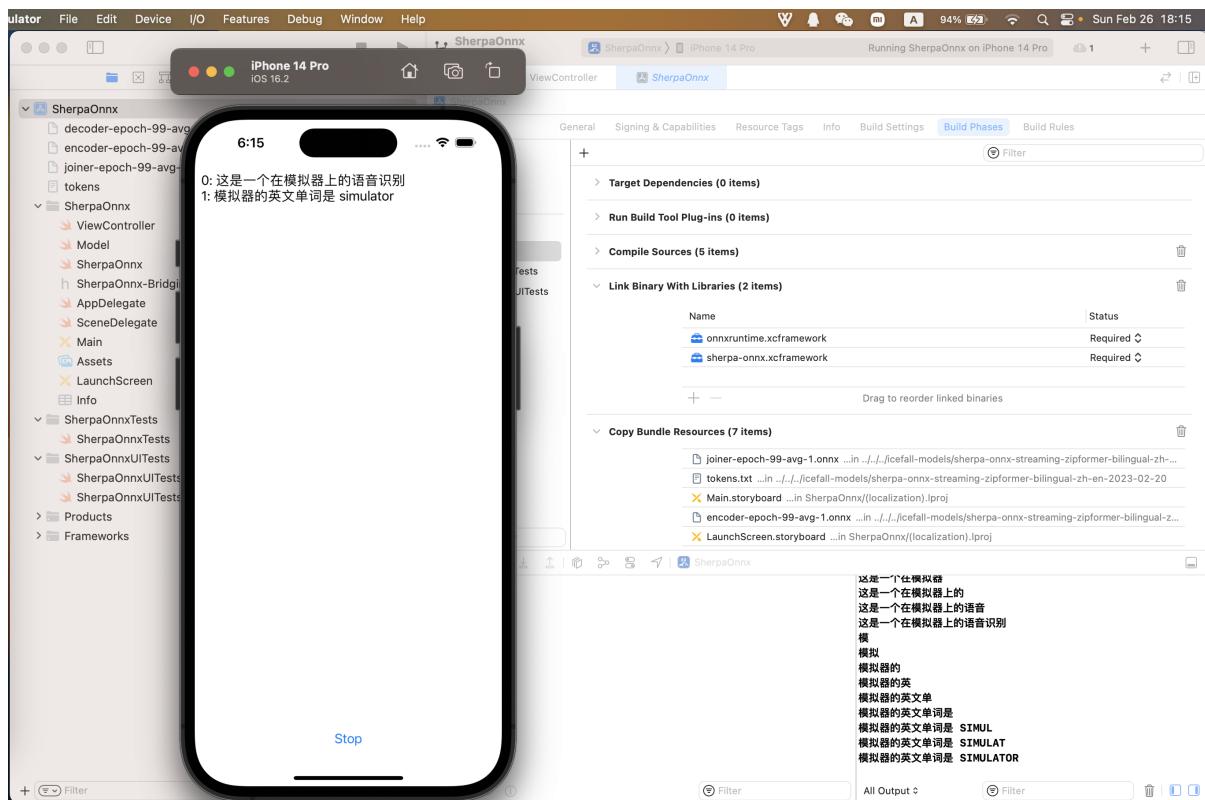


Fig. 8.16: Screenshot for recording and recognition.

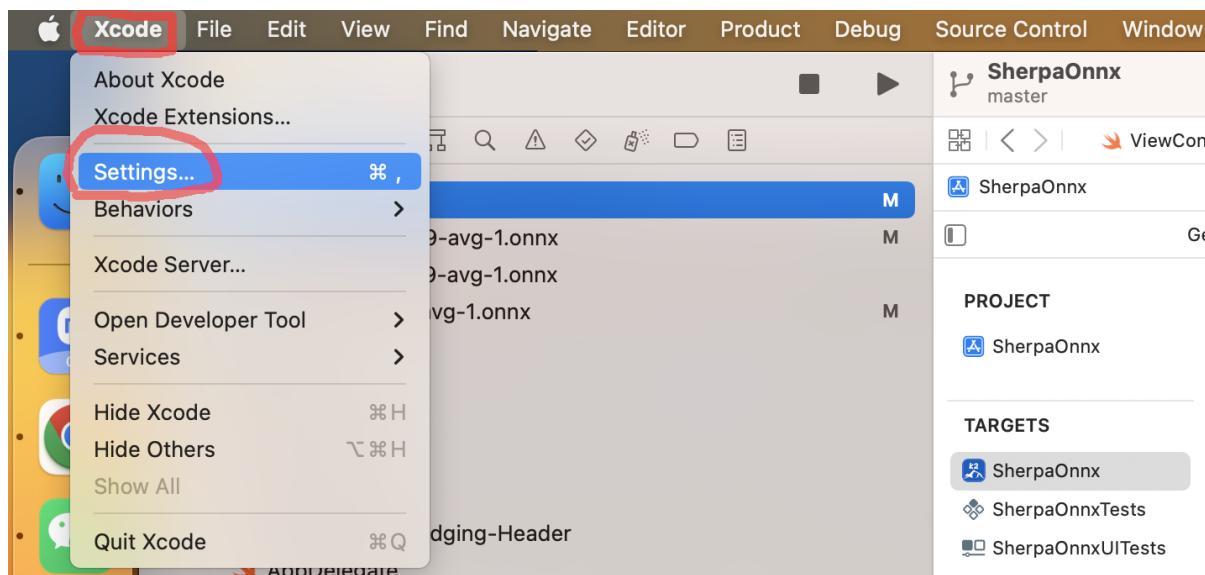


Fig. 8.17: Screenshot for Xcode → Settings...

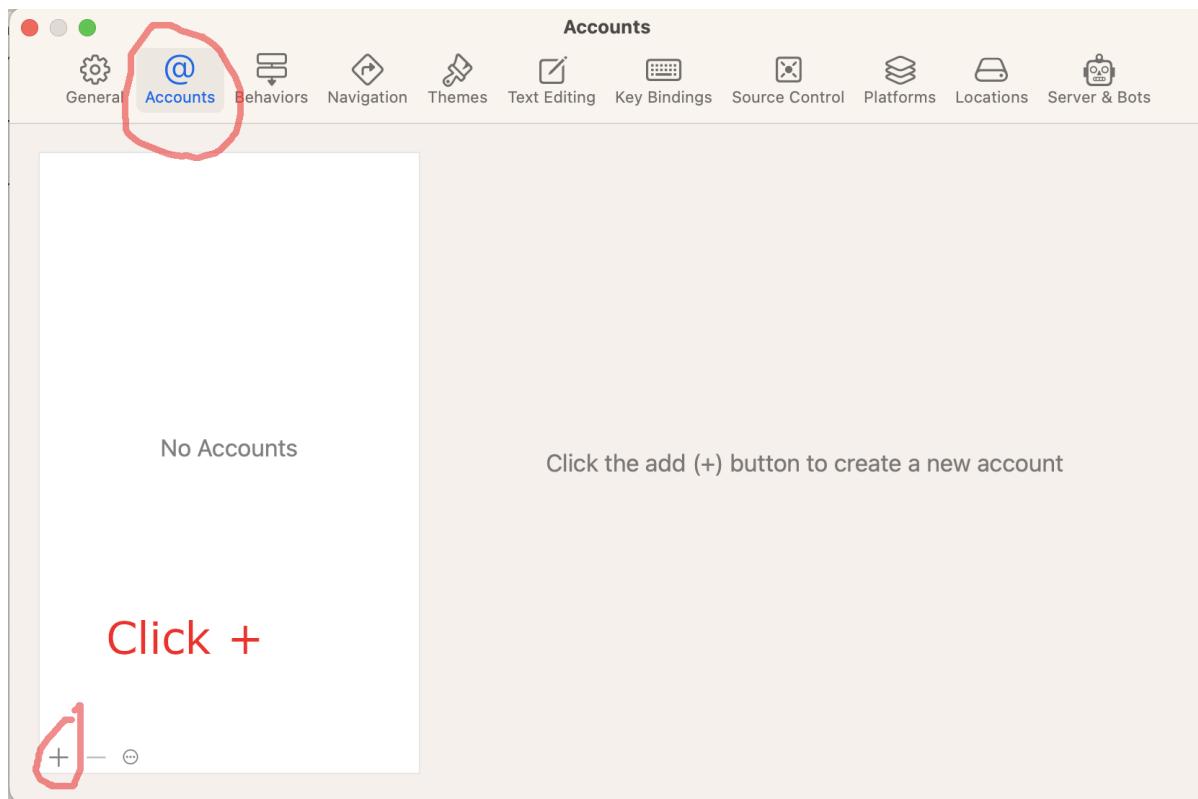


Fig. 8.18: Screenshot for selecting Account and click +.

It does not depend on `boost`.

---

### 8.15.1 Streaming WebSocket server and client

---

**Hint:** Please refer to [Installation](#) to install `sherpa-onnx` before you read this section.

---

#### Build `sherpa-onnx` with WebSocket support

By default, it will generate the following binaries after [Installation](#):

```
sherpa-onnx fangjun$ ls -lh build/bin/*websocket*
-rwxr-xr-x 1 fangjun staff 1.1M Mar 31 22:09 build/bin/sherpa-onnx-offline-websocket-
 ↵server
-rwxr-xr-x 1 fangjun staff 1.0M Mar 31 22:09 build/bin/sherpa-onnx-online-websocket-
 ↵client
-rwxr-xr-x 1 fangjun staff 1.2M Mar 31 22:09 build/bin/sherpa-onnx-online-websocket-
 ↵server
```

Please refer to [Non-streaming WebSocket server and client](#) for the usage of `sherpa-onnx-offline-websocket-server`.

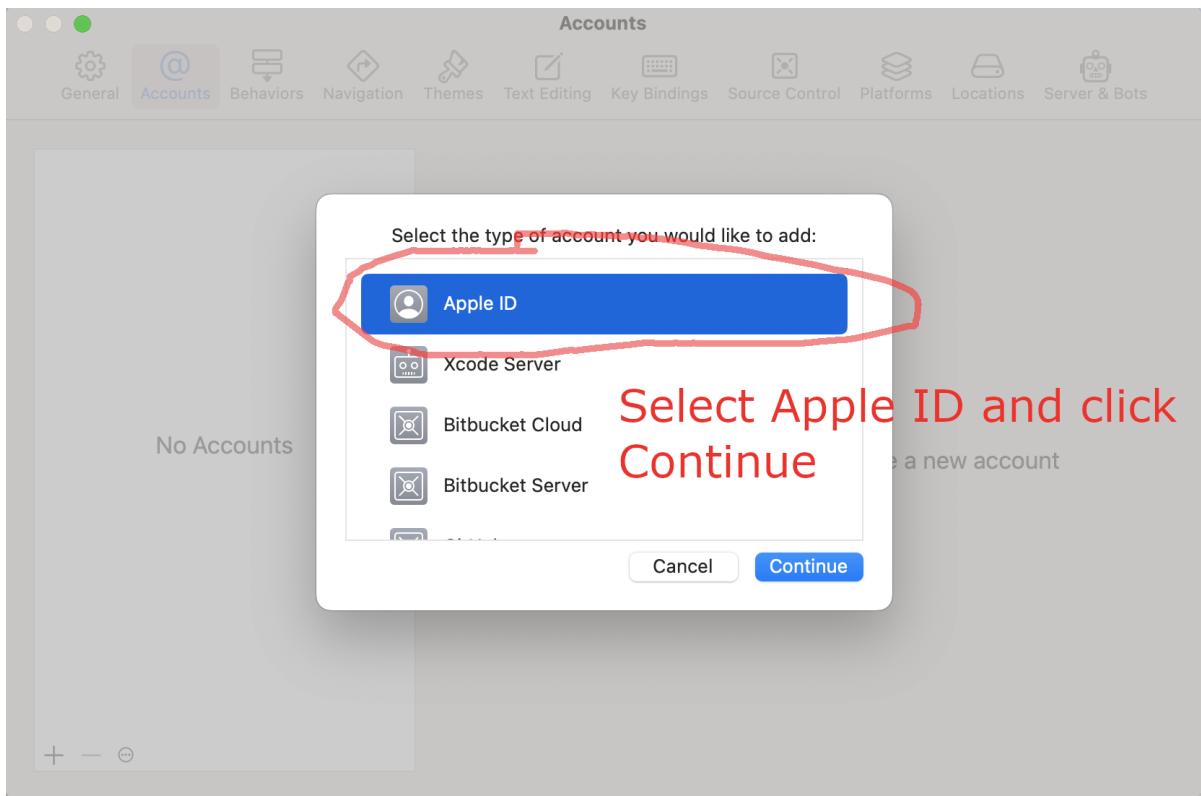


Fig. 8.19: Screenshot for selecting Apple ID and click Continue

### View the server usage

Before starting the server, let us view the help message of `sherpa-onnéx-online-websocket-server`:

```
build/bin/sherpa-onnéx-online-websocket-server
```

The above command will print the following help information:

```
Automatic speech recognition with sherpa-onnéx using websocket.
```

Usage:

```
./bin/sherpa-onnéx-online-websocket-server --help

./bin/sherpa-onnéx-online-websocket-server \
--port=6006 \
--num-work-threads=5 \
--tokens=/path/to/tokens.txt \
--encoder=/path/to/encoder.onnx \
--decoder=/path/to/decoder.onnx \
--joiner=/path/to/joiner.onnx \
--log-file=../log.txt \
--max-batch-size=5 \
```

(continues on next page)

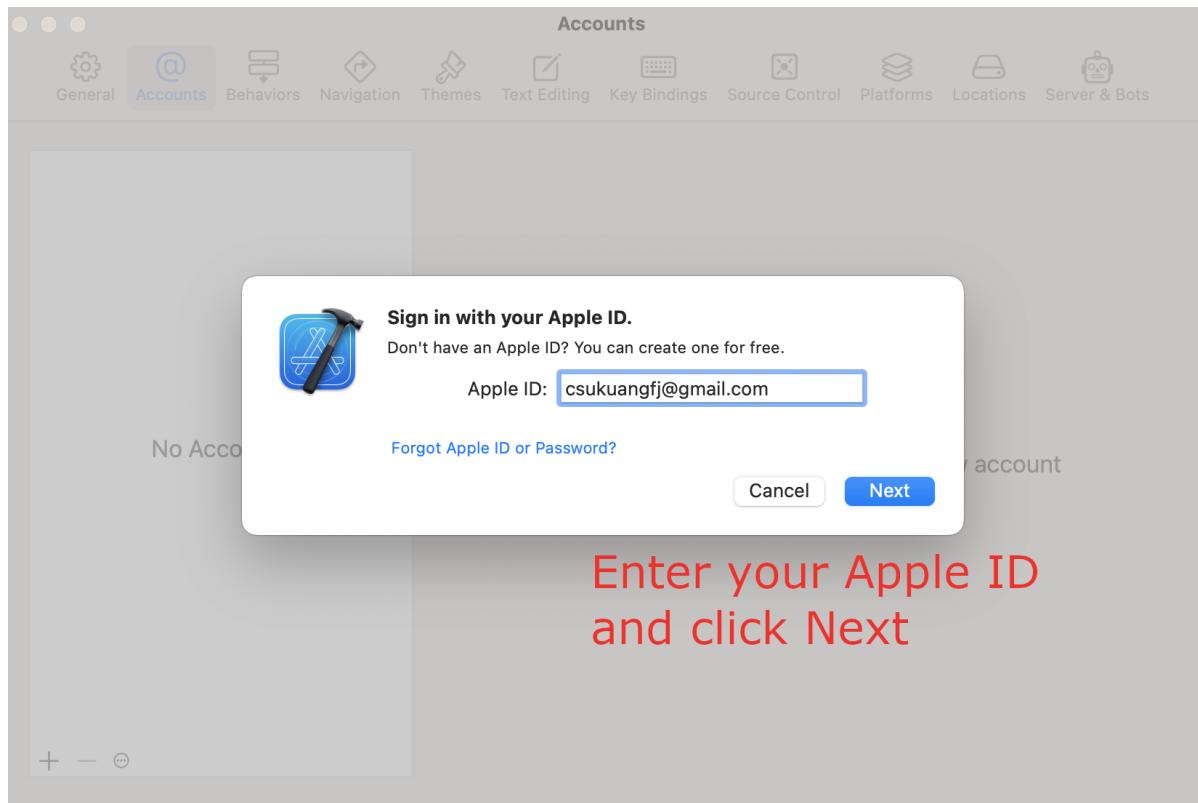


Fig. 8.20: Screenshot for adding your Apple ID and click Next

(continued from previous page)

```
--loop-interval-ms=10

Please refer to
https://k2-fsa.github.io/sherpa/onnx/pretrained\_models/index.html
for a list of pre-trained models to download.

Options:
--max-batch-size : Max batch size for recognition. (int, default = 5)
--loop-interval-ms : It determines how often the decoder loop runs. (int, default = 10)
--max-active-paths : beam size used in modified beam search. (int, default = 4)
--decoding-method : decoding method, now support greedy_search and modified_beam_search. (string, default = "greedy_search")
--rule3-min-utterance-length : This endpointing rule3 requires utterance-length (in seconds) to be >= this value. (float, default = 20)
--rule3-min-trailing-silence : This endpointing rule3 requires duration of trailing silence in seconds) to be >= this value. (float, default = 0)
--rule3-must-contain-nonsilence : If True, for this endpointing rule3 to apply there must be nonsilence in the best-path traceback. For decoding, a non-blank token is considered as non-silence (bool, default = false)
--rule2-min-utterance-length : This endpointing rule2 requires utterance-length (in seconds) to be >= this value. (float, default = 0)
```

(continues on next page)

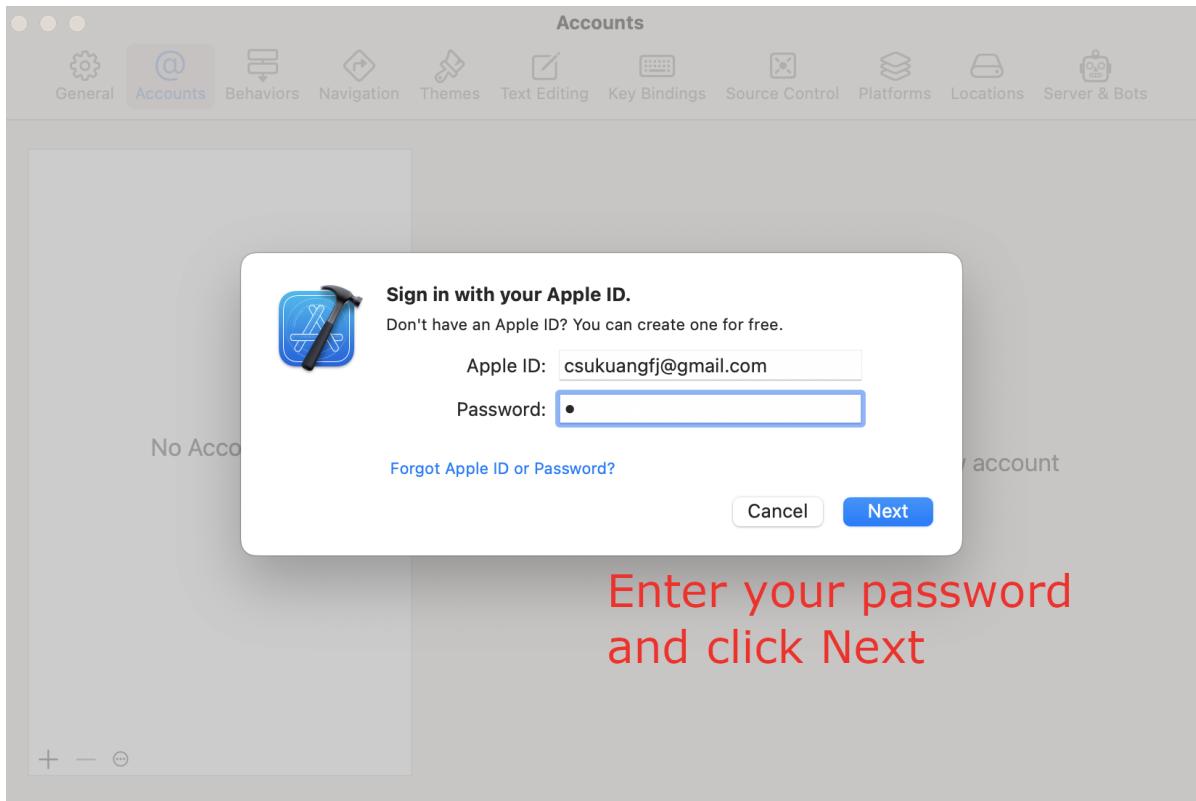


Fig. 8.21: Screenshot for entering your password and click Next

(continued from previous page)

```
--rule1-min-trailing-silence : This endpointing rule1 requires duration of trailing silence in seconds) to be >= this value. (float, default = 2.4)
--feat-dim : Feature dimension. Must match the one expected by the model. (int, default = 80)
--rule1-must-contain-nonsilence : If True, for this endpointing rule1 to apply there must be nonsilence in the best-path traceback. For decoding, a non-blank token is considered as non-silence (bool, default = false)
--enable-endpoint : True to enable endpoint detection. False to disable it. (bool, default = true)
--num_threads : Number of threads to run the neural network (int, default = 2)
--debug : true to print model information while loading it. (bool, default = false)
--port : The port on which the server will listen. (int, default = 6006)
--num-io-threads : Thread pool size for network connections. (int, default = 1)
--rule2-must-contain-nonsilence : If True, for this endpointing rule2 to apply there must be nonsilence in the best-path traceback. For decoding, a non-blank token is considered as non-silence (bool, default = true)
--joiner : Path to joiner.onnx (string, default = "")
--tokens : Path to tokens.txt (string, default = "")
--num-work-threads : Thread pool size for neural network computation and decoding. (int, default = 3)
```

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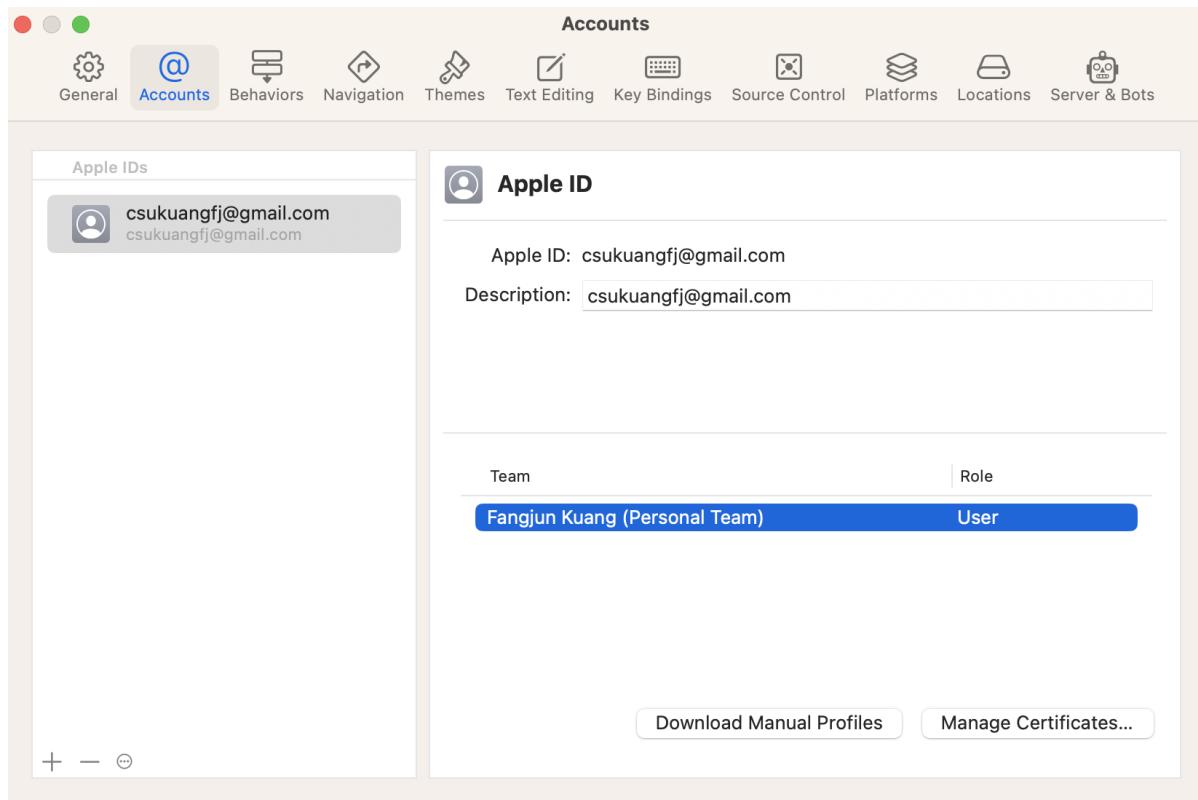


Fig. 8.22: Screenshot after adding your Apple ID

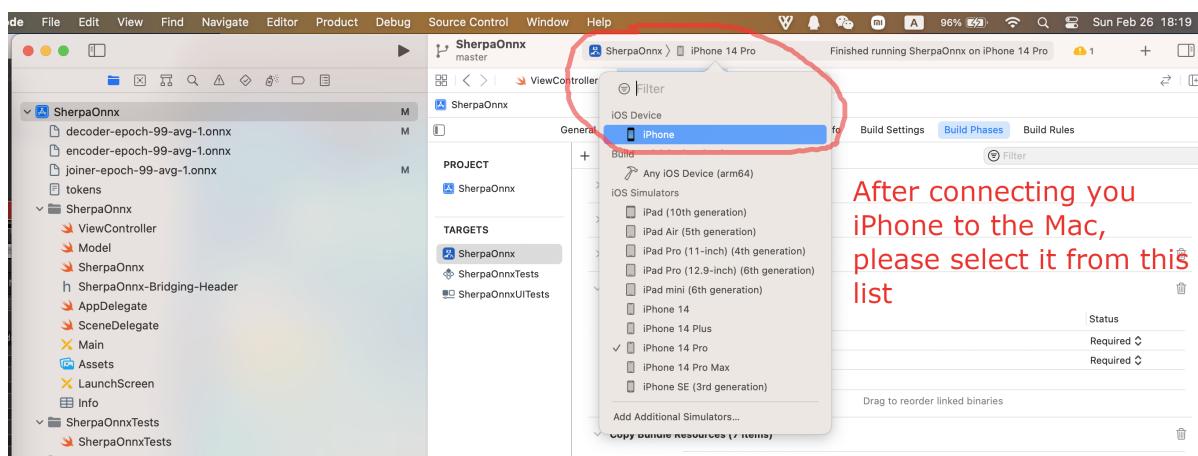


Fig. 8.23: Screenshot for selecting your device

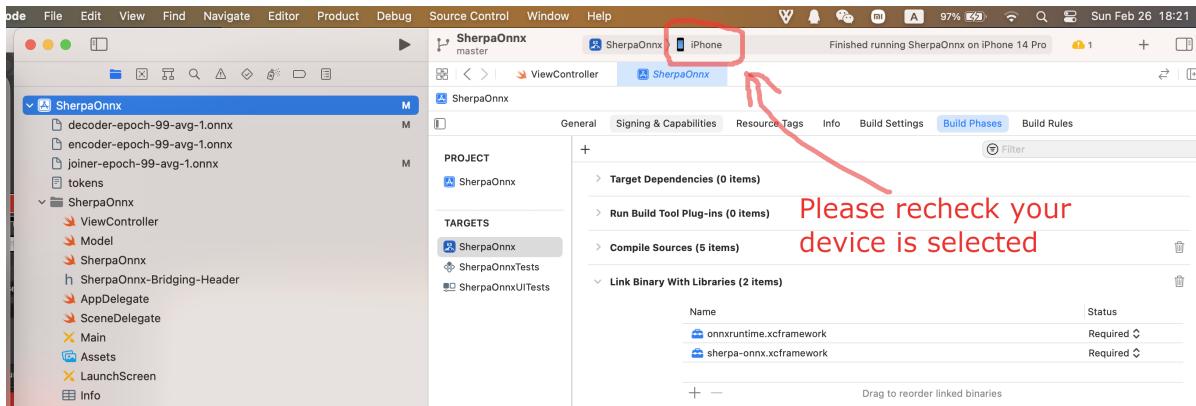


Fig. 8.24: Screenshot after selecting your device

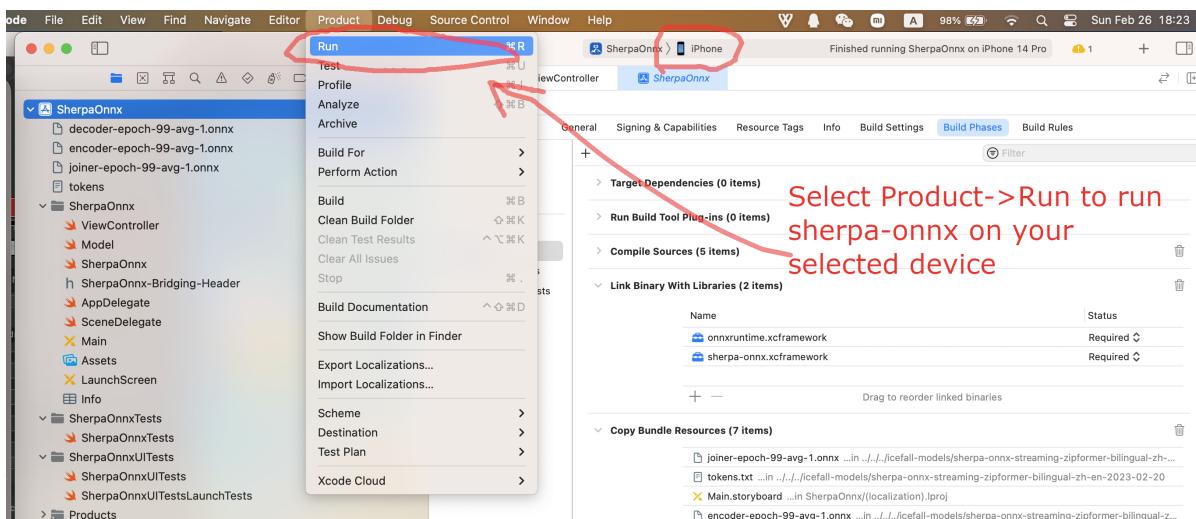


Fig. 8.25: Screenshot for selecting Product -&gt; Run



Fig. 8.26: Screenshot for running sherpa-onnx on your device

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ASR with Next-gen Kaldi

See <https://github.com/k2-fsa/sherpa-onnx>

Press the Start button to run!

Press "Start"

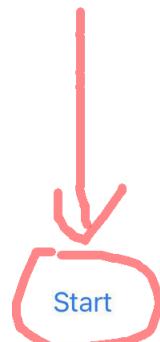


Fig. 8.27: Screenshot for running `sherpa-onnx` on iPhone

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```
--encoder           : Path to encoder.onnx (string, default = "")  

--sample-rate      : Sampling rate of the input waveform. Note: You can have  

a different sample rate for the input waveform. We will do resampling inside the  

feature extractor \(int, default = 16000\)  

--rule2-min-trailing-silence : This endpointing rule2 requires duration of trailing  

silence in seconds\) to be >= this value. \(float, default = 1.2\)  

--log-file         : Path to the log file. Logs are appended to this file  

\(string, default = "./log.txt"\)  

--rule1-min-utterance-length : This endpointing rule1 requires utterance-length (in  

seconds\) to be >= this value. \(float, default = 0\)  

--decoder          : Path to decoder.onnx (string, default = "")  

Standard options:  

--config           : Configuration file to read (this option may be repeated)  

\(string, default = ""\)  

--help              : Print out usage message (bool, default = false)  

--print-args        : Print the command line arguments (to stderr) (bool,  

default = true\)
```

## Start the server

**Hint:** Please refer to [Pre-trained models](#) for a list of pre-trained models.

```
./build/bin/sherpa-onnx-online-websocket-server \  

--port=6006 \  

--num-work-threads=3 \  

--num-io-threads=2 \  

--tokens=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/tokens.txt \  

--encoder=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/encoder-epoch-  

99-avg-1.onnx \  

--decoder=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/decoder-epoch-  

99-avg-1.onnx \  

--joiner=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/joiner-epoch-99-  

avg-1.onnx \  

--log-file=./log.txt \  

--max-batch-size=5 \  

--loop-interval-ms=20
```

**Caution:** The arguments are in the form `--key=value`.

It does not support `--key value`.

It does not support `--key value`.

It does not support `--key value`.

---

**Hint:** In the above demo, the model files are from [csukuangfj/sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20](https://github.com/csukuangfj/sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20) (*Bilingual, Chinese + English*).

---



---

**Note:** Note that the server supports processing multiple clients in a batch in parallel. You can use `--max-batch-size` to limit the batch size.

---

### View the usage of the client (C++)

Let us view the usage of the C++ `WebSocket` client:

```
./build/bin/sherpa-onnx-online-websocket-client
```

The above command will print the following help information:

```
[I] /Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:484:int
↳sherpa_onnx::ParseOptions::Read(int, const char *const *) ./build/bin/sherpa-onnx-
↳online-websocket-client
[I] /Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:525:void
↳sherpa_onnx::ParseOptions::PrintUsage(bool) const
```

Automatic speech recognition **with** `sherpa-onnx` using `websocket`.

Usage:

```
./bin/sherpa-onnx-online-websocket-client --help
```

```
./bin/sherpa-onnx-online-websocket-client \
--server-ip=127.0.0.1 \
--server-port=6006 \
--samples-per-message=8000 \
--seconds-per-message=0.2 \
/path/to/foo.wav
```

It support only wave of **with** a single channel, 16kHz, 16-bit samples.

Options:

```
--seconds-per-message      : We will simulate that each message takes this number of_
↳seconds to send. If you select a very large value, it will take a long time to send_
↳all the samples (float, default = 0.2)
--samples-per-message     : Send this number of samples per message. (int, default =
↳8000)
--sample-rate              : Sample rate of the input wave. Should be the one_
↳expected by the server (int, default = 16000)
--server-port               : Port of the websocket server (int, default = 6006)
--server-ip                 : IP address of the websocket server (string, default =
↳"127.0.0.1")
```

Standard options:

```
--help                      : Print out usage message (bool, default = false)
```

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```
--print-args          : Print the command line arguments (to stderr) (bool, )
--default = true)
--config             : Configuration file to read (this option may be repeated)
--(string, default = "")
```

**Caution:** We only support using IP address for --server-ip.

For instance, please don't use --server-ip=localhost, use --server-ip=127.0.0.1 instead.

For instance, please don't use --server-ip=localhost, use --server-ip=127.0.0.1 instead.

For instance, please don't use --server-ip=localhost, use --server-ip=127.0.0.1 instead.

## Start the client (C++)

To start the C++ `WebSocket` client, use:

```
build/bin/sherpa-onnx-online-websocket-client \
  --seconds-per-message=0.1 \
  --server-port=6006 \
  ./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/test_wavs/0.wav
```

Since the server is able to process multiple clients at the same time, you can use the following command to start multiple clients:

```
for i in $(seq 0 10); do
  k=$((expr $i % 5))
  build/bin/sherpa-onnx-online-websocket-client \
    --seconds-per-message=0.1 \
    --server-port=6006 \
    ./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/test_wavs/${k}.wav &
done

wait

echo "done"
```

## View the usage of the client (Python)

Use the following command to view the usage:

```
python3 ./python-api-examples/online-websocket-client-decode-file.py --help
```

---

**Hint:** `online-websocket-client-decode-file.py` is from <https://github.com/k2-fsa/sherpa-onnx/blob/master/python-api-examples/online-websocket-client-decode-file.py>

---

It will print:

```

usage: online-websocket-client-decode-file.py [-h] [--server-addr SERVER_ADDR]
                                              [--server-port SERVER_PORT]
                                              [--samples-per-message SAMPLES_PER_MESSAGE]
                                              [--seconds-per-message SECONDS_PER_MESSAGE]
                                              sound_file

positional arguments:
  sound_file            The input sound file. Must be wave with a single
                        channel, 16kHz sampling rate, 16-bit of each sample.

optional arguments:
  -h, --help            show this help message and exit
  --server-addr SERVER_ADDR
                        Address of the server (default: localhost)
  --server-port SERVER_PORT
                        Port of the server (default: 6006)
  --samples-per-message SAMPLES_PER_MESSAGE
                        Number of samples per message (default: 8000)
  --seconds-per-message SECONDS_PER_MESSAGE
                        We will simulate that the duration of two messages is
                        of this value (default: 0.1)

```

**Hint:** For the Python client, you can use either a domain name or an IP address for `--server-addr`. For instance, you can use either `--server-addr localhost` or `--server-addr 127.0.0.1`.

For the `input` argument, you can either use `--key=value` or `--key value`.

### Start the client (Python)

```

python3 ./python-api-examples/online-websocket-client-decode-file.py \
  --server-addr localhost \
  --server-port 6006 \
  --seconds-per-message 0.1 \
  ./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/test_wavs/4.wav

```

### Start the client (Python, with microphone)

```

python3 ./python-api-examples/online-websocket-client-microphone.py \
  --server-addr localhost \
  --server-port 6006

``online-websocket-client-microphone.py`` is from
`<https://github.com/k2-fsa/sherpa-onnx/blob/master/python-api-examples/online-
websocket-client-microphone.py>`_

```

## 8.15.2 Non-streaming WebSocket server and client

---

**Hint:** Please refer to [Installation](#) to install `sherpa-onnx` before you read this section.

---

### Build `sherpa-onnx` with WebSocket support

By default, it will generate the following binaries after [Installation](#):

```
sherpa-onnx fangjun$ ls -lh build/bin/*websocket*
-rwxr-xr-x 1 fangjun staff 1.1M Mar 31 22:09 build/bin/sherpa-onnx-offline-websocket-
 ↵server
-rwxr-xr-x 1 fangjun staff 1.0M Mar 31 22:09 build/bin/sherpa-onnx-online-websocket-
 ↵client
-rwxr-xr-x 1 fangjun staff 1.2M Mar 31 22:09 build/bin/sherpa-onnx-online-websocket-
 ↵server
```

Please refer to [Streaming WebSocket server and client](#) for the usage of `sherpa-onnx-online-websocket-server` and `sherpa-onnx-online-websocket-client`.

### View the server usage

Before starting the server, let us view the help message of `sherpa-onnx-offline-websocket-server`:

```
build/bin/sherpa-onnx-offline-websocket-server
```

The above command will print the following help information:

```
Automatic speech recognition with sherpa-onnx using websocket.
```

Usage:

```
./bin/sherpa-onnx-offline-websocket-server --help
```

(1) For transducer models

```
./bin/sherpa-onnx-offline-websocket-server \
--port=6006 \
--num-work-threads=5 \
--tokens=/path/to/tokens.txt \
--encoder=/path/to/encoder.onnx \
--decoder=/path/to/decoder.onnx \
--joiner=/path/to/joiner.onnx \
--log-file=./log.txt \
--max-batch-size=5
```

(2) For Paraformer

```
./bin/sherpa-onnx-offline-websocket-server \
--port=6006 \
--num-work-threads=5 \
```

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```
--tokens=/path/to/tokens.txt \
--paraformer=/path/to/model.onnx \
--log-file=./log.txt \
--max-batch-size=5

Please refer to
https://k2-fsa.github.io/sherpa/onnx/pretrained\_models/index.html
for a list of pre-trained models to download.

Options:
  --log-file           : Path to the log file. Logs are appended to this file.
  (string, default = "./log.txt")
  --max-utterance-length : Max utterance length in seconds. If we receive an
  utterance longer than this value, we will reject the connection. If you have enough
  memory, you can select a large value for it. (float, default = 300)
  --decoding-method      : decoding method,Valid values: greedy_search. (string,
  default = "greedy_search")
  --num-threads          : Number of threads to run the neural network (int,
  default = 2)
  --feat-dim             : Feature dimension. Must match the one expected by the
  model. (int, default = 80)
  --port                 : The port on which the server will listen. (int, default
  = 6006)
  --debug                : true to print model information while loading it. (bool,
  default = false)
  --joiner               : Path to joiner.onnx (string, default = "")
  --tokens               : Path to tokens.txt (string, default = "")
  --encoder              : Path to encoder.onnx (string, default = "")
  --num-work-threads     : Thread pool size for neural network computation and
  decoding. (int, default = 3)
  --paraformer            : Path to model.onnx of paraformer. (string, default = "")
  --num-io-threads        : Thread pool size for network connections. (int, default
  = 1)
  --max-batch-size        : Max batch size for decoding. (int, default = 5)
  --decoder               : Path to decoder.onnx (string, default = "")

Standard options:
  --help                  : Print out usage message (bool, default = false)
  --print-args             : Print the command line arguments (to stderr) (bool,
  default = true)
  --config                : Configuration file to read (this option may be repeated)
  (string, default = "")
```

## Start the server

---

**Hint:** Please refer to [Pre-trained models](#) for a list of pre-trained models.

---

### Start the server with a transducer model

```
./build/bin/sherpa-onnx-offline-websocket-server \
--port=6006 \
--num-work-threads=5 \
--tokens=./sherpa-onnx-zipformer-en-2023-03-30/tokens.txt \
--encoder=./sherpa-onnx-zipformer-en-2023-03-30/encoder-epoch-99-avg-1.onnx \
--decoder=./sherpa-onnx-zipformer-en-2023-03-30/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-zipformer-en-2023-03-30/joiner-epoch-99-avg-1.onnx \
--log-file=./log.txt \
--max-batch-size=5
```

**Caution:** The arguments are in the form `--key=value`.

It does not support `--key value`.

It does not support `--key value`.

It does not support `--key value`.

---

**Hint:** In the above demo, the model files are from [csukuangfj/sherpa-onnx-zipformer-en-2023-03-30 \(English\)](#).

---

---

**Note:** Note that the server supports processing multiple clients in a batch in parallel. You can use `--max-batch-size` to limit the batch size.

---

### Start the server with a paraformer model

```
./build/bin/sherpa-onnx-offline-websocket-server \
--port=6006 \
--num-work-threads=5 \
--tokens=./sherpa-onnx-paraformer-zh-2023-03-28/tokens.txt \
--paraformer=./sherpa-onnx-paraformer-zh-2023-03-28/model.onnx \
--log-file=./log.txt \
--max-batch-size=5
```

---

**Hint:** In the above demo, the model files are from [csukuangfj/sherpa-onnx-paraformer-zh-2023-03-28 \(Chinese + English\)](#).

---

## Start the client (Python)

We provide two clients written in Python:

- `offline-websocket-client-decode-files-paralell.py`: It decodes multiple files in parallel by creating a separate connection for each file
- `offline-websocket-client-decode-files-sequential.py`: It decodes multiple files sequentially by creating only a single connection

### offline-websocket-client-decode-files-paralell.py

```
python3 ./python-api-examples/offline-websocket-client-decode-files-paralell.py \
--server-addr localhost \
--server-port 6006 \
./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/0.wav \
./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/1.wav \
./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/2.wav \
./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/8k.wav
```

### offline-websocket-client-decode-files-sequential.py

```
python3 ./python-api-examples/offline-websocket-client-decode-files-sequential.py \
--server-addr localhost \
--server-port 6006 \
./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/0.wav \
./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/1.wav \
./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/2.wav \
./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/8k.wav
```

## 8.16 Hotwords (Contextual biasing)

In this section, we describe how we implement the hotwords (aka contextual biasing) feature with an Aho-corasick automaton and how to use it in `sherpa-onnx`.

### 8.16.1 What are hotwords

Current ASR systems work very well for general cases, but they sometimes fail to recognize special words/phrases (aka hotwords) like rare words, personalized information etc. Usually, those words/phrases will be recognized as the words/phrases that pronounce similar to them (for example, recognize LOUIS FOURTEEN as LEWIS FOURTEEN). So we have to provide some kind of contexts information (for example, the LOUIS FOURTEEN) to the ASR systems to boost those words/phrases. Normally, we call this kind of boosting task contextual biasing (aka hotwords recognition).

### 8.16.2 How do we implement it with an Aho-corasick

We first construct an Aho-corasick automaton on those given hotwords (after tokenizing into tokens). Please refer to [https://en.wikipedia.org/wiki/Aho%20Corasick\\_algorithm](https://en.wikipedia.org/wiki/Aho%20Corasick_algorithm) for the construction details of Aho-corasick.

The figure below is the aho-corasick on “HE/SHE/SHELL/HIS/THIS” with hotwords-score==1.

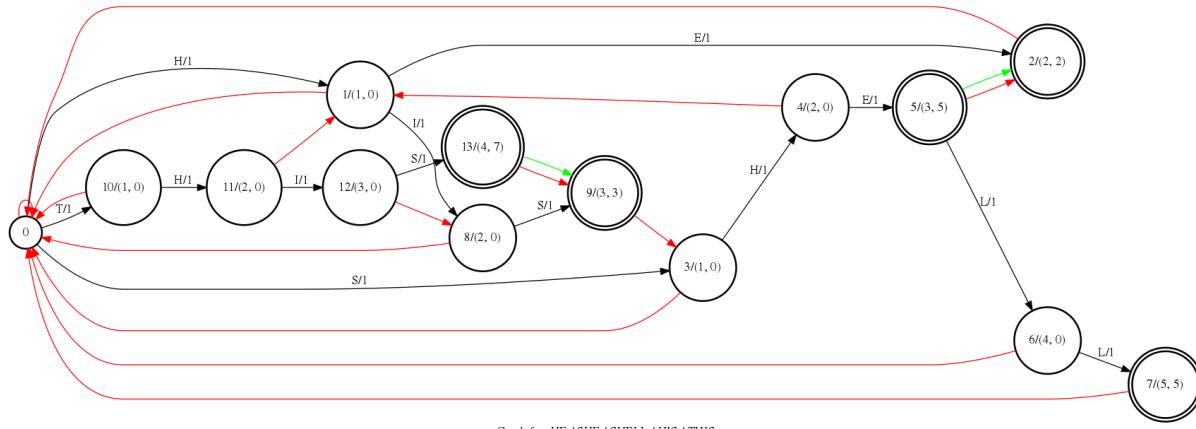


Fig. 8.28: The Aho-corasick for “HE/SHE/SHELL/HIS/THIS”

The black arrows in the graph are the goto arcs, the red arrows are the failure arcs, the green arrows are the output arcs. On each goto arc, there are token and boosting score (Note: we will boost the path when any partial sequence is matched, if the path finally fails to full match any hotwords, the boosted score will be canceled). Currently, the boosting score distributes on the arcs evenly along the path. On each state, there are two scores, the first one is the node score (mainly used to cancel score) the second one is output score, the output score is the total scores of the full matched hotwords of this state.

The following are several matching examples of the graph above.

**Note:** For simplicity, we assume that the system emits a token each frame.

**Hint:** We have an extra `finalize` step to force the graph state to go back to the root state.

**The path is “SHELF”**

Frame	Boost score	Total boost score	Graph state	Matched hotwords
init	0	0	0	
1	1	1	3	
2	1	2	4	
3	1 + 5	8	5	HE, SHE
4	1	9	6	
5	-4	5	0	
finalize	0	5	0	

At frame 3 we reach state 5 and match HE, SHE, so we get a boosting score 1 + 5, the score 1 here because the SHEL still might be the prefix of other hotwords. At frame 5 F can not match any tokens and fail back to root, so we cancel the score for SHEL which is 4 (the node score of state 6).

The path is “HI”

Frame	Boost score	Total boost score	Graph state	Matched hotwords
init	0	0	0	
1	1	1	1	
2	1	2	8	
finalize	-2	0	0	

H and I all match the tokens in the graph, unfortunately, we have to go back to root state when finishing matching a path, so we cancel the boosting score of HI which is 2 (the node score of state 8).

The path is “THE”

Frame	Boost score	Total boost score	Graph state	Matched hotwords
init	0	0	0	
1	1	1	10	
2	1	2	11	
3	0 + 2	4	2	HE
finalize	-2	3	0	

At frame 3 we jump from state 11 to state 2 and get a boosting score of 0 + 2, 0 because the node score of state 2 is the same as state 11 so we don't get score by partial match (the prefix of state 11 is TH has the same length of the prefix of state 2 which is HE), but we do get the output score (at state 2 it outputs HE).

---

**Note:** We implement the hotwords feature during inference time, you don't have to re-train the models to use this feature.

---

### 8.16.3 How to use hotwords in sherpa-onnx

**Caution:** Currently, the hotwords feature is only supported in the `modified_beam_search` decoding method of the **transducer models** (both streaming and non-streaming).

The use of the hotwords is no different for streaming and non-streaming models, and in fact it is even no different for all the API supported by sherpa onnx. We add **FOUR** extra arguments for hotwords:

- `hotwords-file`

The file path of the hotwords, one hotwords per line. They could be Chinese words, English words or both according to the modeling units used to train the model. Here are some examples:

For Chinese models trained on `cjkchar` it looks like:



For English like language models trained on `bpe` it looks like:



For multilingual models trained on `cjkchar+bpe` (Chinese + English) it looks like:

```
SPEECH
SPEECH RECOGNITION
```

You can also specify the boosting score for each hotword, the score should follow the predefined character :, for example:

```
:3.5
:2.0
```

It means, hotword will have a boosting score of 3.5, hotword will have a boosting score of 2.0. For those hotwords that don't have specific scores, they will use the global score provided by *hotword-score* below.

**Caution:** The specific score MUST BE the last item of each hotword (i.e You shouldn't break the hotword into two parts by the score). SPEECH :2.0 # This is invalid

- **hotwords-score**

The boosting score for each matched token.

---

**Note:** We match the hotwords at token level, so the **hotwords-score** is applied at token level.

---

- **modeling-unit**

The modeling unit of the used model, currently support *cjkchar* (for Chinese), *bpe* (for English like languages) and *cjkchar+bpe* (for multilingual models). We need this modeling-unit to select tokenizer to encode words/phrases into tokens, so **do provide correct modeling-unit according to your model**.

- **bpe-vocab**

The bpe vocabulary generated by sentencepiece toolkit, it also can be exported from *bpe.model* (see *script/export\_bpe\_vocab.py* for details). This vocabulary is used to tokenize words/phrases into bpe units. It is only used when *modeling-unit* is *bpe* or *cjkchar+bpe*.

---

**Hint:** We need *bpe.vocab* rather than *bpe.model*, because we don't introduce sentencepiece c++ codebase into *sherpa-onnx* (which has a dependency issue of protobuf), we implement a simple sentencepiece encoder and decoder which takes *bpe.vocab* as input.

---

The main difference of using hotwords feature is about the modeling units. The following shows how to use it for different modeling units.

---

**Hint:** You can use any transducer models here [https://k2-fsa.github.io/sherpa/onnx/pretrained\\_models/index.html](https://k2-fsa.github.io/sherpa/onnx/pretrained_models/index.html), we just choose three of them randomly for the following examples.

---

---

**Note:** In the following example, we use a non-streaming model, if you are using a streaming model, you should use *sherpa-onnx*. *sherpa-onnx-alsa*, *sherpa-onnx-microphone*, *sherpa-onnx-microphone-offline*, *sherpa-onnx-online-websocket-server* and *sherpa-onnx-offline-websocket-server* all support hotwords.

---

## Modeling unit is bpe

### Download the model

```
cd /path/to/sherpa-onnx
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
zipformer-en-2023-04-01.tar.bz2
tar xvf sherpa-onnx-zipformer-en-2023-04-01.tar.bz2
rm sherpa-onnx-zipformer-en-2023-04-01.tar.bz2
ln -s sherpa-onnx-zipformer-en-2023-04-01 exp
```

Export bpe.vocab if you can't find bpe.vocab in the model directory.

```
python script/export_bpe_vocab.py --bpe-model exp/bpe.model
```

The hotwords\_en.txt contains:

```
QUARTERS
FOREVER
```

## C++ api

### Decoding without hotwords

```
./build/bin/sherpa-onnx-offline \
--encoder=exp/encoder-epoch-99-avg-1.onnx \
--decoder=exp/decoder-epoch-99-avg-1.onnx \
--joiner=exp/joiner-epoch-99-avg-1.onnx \
--decoding-method=modified_beam_search \
--tokens=exp/tokens.txt \
exp/test_wavs/0.wav exp/test_wavs/1.wav
```

The output is:

```
/star-kw/kangwei/code/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./build/bin/
sherpa-onnx-offline --encoder=exp/encoder-epoch-99-avg-1.onnx --decoder=exp/decoder-
epoch-99-avg-1.onnx --joiner=exp/joiner-epoch-99-avg-1.onnx --decoding-method=modified_
beam_search --tokens=exp/tokens.txt exp/test_wavs/0.wav exp/test_wavs/1.wav

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,_
feature_dim=80), model_config=OfflineModelConfig(transducer=OfflineTrans-
ducerModelConfig(encoder_filename="exp/encoder-epoch-99-avg-1.onnx", decoder_filename=
"exp/decoder-epoch-99-avg-1.onnx", joiner_filename="exp/joiner-epoch-99-avg-1.onnx"),_
paraformer=OfflineParaformerModelConfig(model=""), nemo_
ctc=OfflineNemoEncDecCtcModelConfig(model=""),_
whisper=OfflineWhisperModelConfig(encoder="", decoder="", language="", task="transcribe
"), tdnn=OfflineTdnModelConfig(model=""), tokens="exp/tokens.txt", num_threads$2,_
debug=False, provider="cpu", model_type=""), lm_config=OfflineLMConfig(model="",
scale=0.5), decoding_method="modified_beam_search", max_active_paths=4, hotwords_file=,
hotwords_score=1.5)
Creating recognizer ...
Started
```

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Done!

```

exp/test_wavs/0.wav
{"text":"ALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID QUARTER OF THE
→BROTHELS","timestamps":[1.44, 1.48, 1.56, 1.72, 1.88, 1.96, 2.16, 2.28$ 2.36, 2.48, 2.
→60, 2.80, 3.08, 3.28, 3.40, 3.60, 3.80, 4.08, 4.24, 4.32, 4.48, 4.64, 4.84, 4.88, 5.00,
→5.08, 5.32, 5.48, 5.60, 5.68, 5.84, 6.04, 6.24],"tokens$":["A","LL"," THE"," YE","LL",
→"OW"," LA","M","P","S"," WOULD"," LIGHT"," UP"," HE","RE"," AND"," THERE"," THE"," S",
→"QUA","LI","D"," ","QUA","R","TER"," OF","THE"," B","RO","TH","EL","S"]}

exp/test_wavs/1.wav
{"text":"IN WHICH MAN THUS PUNISHED HAD GIVEN HER A LOVELY CHILD WHOSE PLACE WAS ON THAT
→SAME DISHONORED BOSOM TO CONNECT HER PARENT FOR EVER WITH THE RACE AN
D DESCENT OF MORTALS AND TO BE FINALLY A BLESSED SOUL IN HEAVEN","timestamps": "[2.44, 2.
→64, 2.88, 3.16, 3.28, 3.48, 3.60, 3.80, 3.96, 4.12, 4.36, 4.52, 4.72, 4
.92, 5.16, 5.44, 5.68, 6.04, 6.24, 6.48, 6.84, 7.08, 7.32, 7.56, 7.84, 8.12, 8.24, 8.32,
→8.44, 8.60, 8.76, 8.88, 9.08, 9.28, 9.44, 9.56, 9.64, 9.76, 9.96, 10.0
4, 10.20, 10.40, 10.64, 10.76, 11.04, 11.20, 11.36, 11.60, 11.80, 12.00, 12.12, 12.28,
→12.32, 12.52, 12.72, 12.84, 12.96, 13.04, 13.24, 13.40, 13.60, 13.76, 13
.96, 14.12, 14.24, 14.36, 14.52, 14.68, 14.76, 15.04, 15.28, 15.52, 15.76, 16.00, 16.16,
→16.24, 16.32],"tokens": ["IN", " WHICH", " MAN", " TH", "US", " P", "UN", "IS
H", "ED", " HAD", " GIVE", "N", " HER", " A", " LOVE", "LY", " CHILD", " WHO", "SE", " PLACE", " WAS",
→" ON", " THAT", " SAME", " DIS", "HO", "N", "OUR", "ED", " BO", "S", "OM", " TO",
" CON", "NE", "C", "T", " HER", " P", "AR", "ENT", " FOR", " E", "VER", " WITH", " THE", " RA", "CE", "B
→"AND", " DE", "S", "C", "ENT", " OF", " MO", "R", "T", "AL", "S", " AND", " TO", " B
E", " FI", "N", "AL", "LY", " A", " B", "LESS", "ED", " SO", "UL", " IN", " HE", "A", "VE", "N"]}

num threads: 2
decoding method: modified_beam_search
max active paths: 4
Elapsed seconds: 1.775 s
Real time factor (RTF): 1.775 / 23.340 = 0.076

```

### Decoding with hotwords

```

./build/bin/sherpa-onnx-offline \
--encoder=exp/encoder-epoch-99-avg-1.onnx \
--decoder=exp/decoder-epoch-99-avg-1.onnx \
--joiner=exp/joiner-epoch-99-avg-1.onnx \
--decoding-method=modified_beam_search \
--tokens=exp/tokens.txt \
--modeling-unit=bpe \
--bpe-vocab=exp/bpe.vocab \
--hotwords-file=hotwords_en.txt \
--hotwords-score=2.0 \
exp/test_wavs/0.wav exp/test_wavs/1.wav

```

The output is:

```

/star-kw/kangwei/code/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./build/bin/
→sherpa-onnx-offline --encoder=exp/encoder-epoch-99-avg-1.onnx --decoder=exp/decoder-
→epoch-99-avg-1.onnx --joiner=exp/joiner-epoch-99-avg-1.onnx --decoding-method=modified-
→beam_search --tokens=exp/tokens.txt --hotwords-file=hotwords_en.txt --hotwords-score=2.
→0 exp/test_wavs/0.wav exp/test_wavs/1.wav

```

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```

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000, ↴
    ↴ feature_dim=80), model_ ↴
    ↴ config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename= ↴
    ↴ "exp/encoder-epoch-99-avg-1.onnx", decoder_filename="exp/decoder-epoch-99-avg-1.onnx", ↴
    ↴ joiner_filename="exp/joiner-epoch-99-avg-1.onnx"), ↴
    ↴ paraformer=OfflineParaformerModelConfig(model=""), nemo_ ↴
    ↴ ctc=OfflineNemoEncDecCtcModelConfig(model=""), ↴
    ↴ whisper=OfflineWhisperModelConfig(encoder=" ↴
    ", decoder="", language="", task="transcribe"), tdnn=OfflineTdnnModelConfig(model=""), ↴
    ↴ tokens="exp/tokens.txt", num_threads=2, debug=False, provider="cpu", model_type=""), ↴
    ↴ lm_config=OfflineLMConfig(model="", scale=0.5), decoding_method="modified_beam_search", ↴
    ↴ max_active_paths=4, hotwords_file=hotwords_en.txt, hotwords_score=2)
Creating recognizer ...
Started
Done!

exp/test_wavs/0.wav
{"text": "ALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID QUARTERS OF THE ↴
    ↴ BROTHELS", "timestamps": "[1.44, 1.48, 1.56, 1.72, 1.88, 1.96, 2.16, 2.28 ↴
    , 2.36, 2.48, 2.60, 2.80, 3.08, 3.28, 3.40, 3.60, 3.80, 4.08, 4.24, 4.32, 4.48, 4.64, 4. ↴
    ↴ 84, 4.88, 5.00, 5.08, 5.12, 5.36, 5.48, 5.60, 5.68, 5.84, 6.04, 6.24]", "tokens": ["A", "LL", "THE", "YE", "LL", "OW", "LA", "M", "P", "S", "WOULD", "LIGHT", "UP", "HE", "RE", "AND", "THERE", "THE", "S", "QUA", "LI", "D", "QUA", "R", "TER", "S", "OF", "THE", "B", "RO", "TH", "EL", "S"]}

exp/test_wavs/1.wav
{"text": "IN WHICH MAN THUS PUNISHED HAD GIVEN HER A LOVELY CHILD WHOSE PLACE WAS ON THAT ↴
    ↴ SAME DISHONORED BOSOM TO CONNECT HER PARENT FOREVER WITH THE RACE AN$ DESCENT OF MORTALS AND TO BE FINALLY A BLESSED SOUL IN HEAVEN", "timestamps": "[2.44, 2. ↴
    ↴ 64, 2.88, 3.16, 3.28, 3.48, 3.60, 3.80, 3.96, 4.12, 4.36, 4.52, 4.72, 4$ ↴
    92, 5.16, 5.44, 5.68, 6.04, 6.24, 6.48, 6.84, 7.08, 7.32, 7.56, 7.84, 8.12, 8.24, 8.32, ↴
    ↴ 8.44, 8.60, 8.76, 8.88, 9.08, 9.28, 9.44, 9.56, 9.64, 9.76, 9.96, 10.0$ ↴
    , 10.20, 10.40, 10.68, 10.76, 11.04, 11.20, 11.36, 11.60, 11.80, 12.00, 12.12, 12.28, 12. ↴
    ↴ 32, 12.52, 12.72, 12.84, 12.96, 13.04, 13.24, 13.40, 13.60, 13.76, 13$ ↴
    96, 14.12, 14.24, 14.36, 14.52, 14.68, 14.76, 15.04, 15.28, 15.52, 15.76, 16.00, 16.16, ↴
    ↴ 16.24, 16.32]", "tokens": ["IN", "WHICH", "MAN", "TH", "US", "P", "UN", "IS", "ED", "HAD", "GIVE", "N", "HER", "A", "LOVE", "LY", "CHILD", "WHO", "SE", "PLACE", "WAS", "ON", "THAT", "SAME", "DIS", "HO", "N", "OUR", "ED", "BO", "S", "OM", "TO", "CON", "NE", "C", "T", "HER", "P", "AR", "ENT", "FOR", "E", "VER", "WITH", "THE", "RA", "CE", "AND", "DE", "S", "C", "ENT", "OF", "MO", "R", "T", "AL", "S", "AND", "TO", "BE", "FI", "N", "AL", "LY", "A", "B", "LESS", "ED", "SO", "UL", "IN", "HE", "A", "VE", "N"]}

num threads: 2
decoding method: modified_beam_search
max active paths: 4
Elapsed seconds: 1.522 s
Real time factor (RTF): 1.522 / 23.340 = 0.065

```

**Hint:** QUARTER -> QUARTERS

FOR EVER -> FOREVER

---

## Python api

### Decoding without hotwords

```
python python-api-examples/offline-decode-files.py \
--encoder exp/encoder-epoch-99-avg-1.onnx \
--decoder exp/decoder-epoch-99-avg-1.onnx \
--joiner exp/joiner-epoch-99-avg-1.onnx \
--decoding modified_beam_search \
--tokens exp/tokens.txt \
exp/test_wavs/0.wav exp/test_wavs/1.wav
```

The output is:

```
Started!
Done!
exp/test_wavs/0.wav
ALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID QUARTER OF THE BROTHELS
-----
exp/test_wavs/1.wav
IN WHICH MAN THUS PUNISHED HAD GIVEN HER A LOVELY CHILD WHOSE PLACE WAS ON THAT SAME_
↪DISHONOURED BOSOM TO CONNECT HER PARENT FOR EVER WITH THE RACE AND DESCENT OF MORTALS_
↪AND TO BE FINALLY A BLESSED SOUL IN HEAVEN
-----
num_threads: 1
decoding_method: modified_beam_search
Wave duration: 23.340 s
Elapsed time: 2.546 s
Real time factor (RTF): 2.546/23.340 = 0.109
```

### Decoding with hotwords

```
python python-api-examples/offline-decode-files.py \
--encoder exp/encoder-epoch-99-avg-1.onnx \
--decoder exp/decoder-epoch-99-avg-1.onnx \
--joiner exp/joiner-epoch-99-avg-1.onnx \
--decoding modified_beam_search \
--tokens exp/tokens.txt \
--modeling-unit bpe \
--bpe-vocab exp/bpe.vocab \
--hotwords-file hotwords_en.txt \
--hotwords-score 2.0 \
exp/test_wavs/0.wav exp/test_wavs/1.wav
```

The output is:

```
Started!
Done!
exp/test_wavs/0.wav
ALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID QUARTERS OF THE BROTHELS
```

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```
-----
exp/test_wavs/1.wav
IN WHICH MAN THUS PUNISHED HAD GIVEN HER A LOVELY CHILD WHOSE PLACE WAS ON THAT SAME_
↳ DISHONoured BOSOM TO CONNECT HER PARENT FOREVER WITH THE RACE AND DESCENT OF MORTALS_
↳ AND TO BE FINALLY A BLESSED SOUL IN HEAVEN
-----
num_threads: 1
decoding_method: modified_beam_search
Wave duration: 23.340 s
Elapsed time: 2.463 s
Real time factor (RTF): 2.463/23.340 = 0.106
```

**Hint:** QUARTER -> QUARTERS

FOR EVER -> FOREVER

### Modeling unit is cjkchar

#### Download the model

```
cd /path/to/sherpa-onnx
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
↳ conformer-zh-stateless2-2023-05-23.tar.bz2
tar xvf sherpa-onnx-conformer-zh-stateless2-2023-05-23.tar.bz2
rm sherpa-onnx-conformer-zh-stateless2-2023-05-23.tar.bz2

ln -s sherpa-onnx-conformer-zh-stateless2-2023-05-23 exp-zh
```

The hotwords\_cn.txt contains:

### C++ api

#### Decoding without hotwords

```
./build/bin/sherpa-onnx-offline \
--encoder=exp-zh/encoder-epoch-99-avg-1.onnx \
--decoder=exp-zh/decoder-epoch-99-avg-1.onnx \
--joiner=exp-zh/joiner-epoch-99-avg-1.onnx \
--tokens=exp-zh/tokens.txt \
--decoding-method=modified_beam_search \
exp-zh/test_wavs/3.wav exp-zh/test_wavs/4.wav exp-zh/test_wavs/5.wav exp-zh/test_wavs/6.wav
```

The output is:

```
/star-kw/kangwei/code/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./build/bin/
↳ sherpa-onnx-offline --encoder=exp-zh/encoder-epoch-99-avg-1.onnx --decoder=exp-zh/
↳ decoder-epoch-99-avg-1.onnx --joiner=exp-zh/joiner-epoch-99-avg-1.onnx --tokens=exp-zh/
↳ tokens.txt --decoding-method=modified_beam_search exp-zh/test_wavs/3.wav exp-zh/test_
↳ wavs/4.wav exp-zh/test_wavs/5.wav exp-zh/test_wavs/6.wav

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,_
↳ feature_dim=80), model_
↳ config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename=
↳ "exp-zh/encoder-epoch-99-avg-1.onnx", decoder_filename="exp-zh/decoder-epoch-99-avg-1.
↳ onnx", joiner_filename="exp-zh/joiner-$poch-99-avg-1.onnx"),_
↳ paraformer=OfflineParaformerModelConfig(model=""), nemo_
↳ ctc=OfflineNemoEncDecCtcModelConfig(model=""), whisper=OfflineWhisperModelConfig
↳ $encoder="", decoder="", language="", task="transcribe"),_
↳ tdnn=OfflineTdnnModelConfig(model=""), tokens="exp-zh/tokens.txt", num_threads=2,_
↳ debug=False, provider="cpu", model_type=""), lm_config=OfflineLMConfig(model="",_
↳ scale=0.5), decoding_method="modified_beam_search", max_active$paths=4, hotwords_file=,
↳ hotwords_score=1.5)
Creating recognizer ...
Started
Done!

exp-zh/test_wavs/3.wav
{"text":"","timestamps":"[0.00, 0.16, 0.68, 1.32, 1.72, 2.08, 2.60, 2.88, 3.20, 3.52, 3.
↳ 92, 4.40, 4.68, 5.12, 5.44, 6.36, $.96, 7.32]", "tokens":["","","","","","","","","","","","","",
↳ "", "", "", "", "", "", ""]}
-----
exp-zh/test_wavs/4.wav
{"text":"","timestamps":"[0.00, 0.20, 0.88, 1.36, 1.76, 2.08, 2.28, 2.68, 2.92, 3.16, 3.
↳ 44, 3.80]", "tokens":["","","","","","","","","$",
", "", "", "", "", "", ""]}
-----
exp-zh/test_wavs/5.wav
{"text":"","timestamps":"[0.00, 0.16, 0.88, 1.24, 1.64, 1.96, 2.76, 3.04, 3.32]", "tokens
↳ :"["","","","","","","","","","",""]"}
-----
exp-zh/test_wavs/6.wav
{"text":"","timestamps":"[0.00, 0.16, 0.80, 1.12, 1.44, 1.68, 1.92, 2.16, 2.36, 2.60, 2.
↳ 84, 3.12]", "tokens":["","","","","","","","","$",
", "", "", "", "", ""]}
-----
num threads: 2
decoding method: modified_beam_search
max active paths: 4
Elapsed seconds: 1.883 s
Real time factor (RTF): 1.883 / 20.328 = 0.093
```

### Decoding with hotwords

```
./build/bin/sherpa-onnx-offline \
--encoder=exp-zh/encoder-epoch-99-avg-1.onnx \
--decoder=exp-zh/decoder-epoch-99-avg-1.onnx \
--joiner=exp-zh/joiner-epoch-99-avg-1.onnx \
```

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```

--tokens=exp-zh/tokens.txt \
--decoding-method=modified_beam_search \
--modeling-unit=cjkchar \
--hotwords-file=hotwords_cn.txt \
--hotwords-score=2.0 \
exp-zh/test_wavs/3.wav exp-zh/test_wavs/4.wav exp-zh/test_wavs/5.wav exp-zh/test_wavs/
↪6.wav

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,_
↪feature_dim=80), model_
↪config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename=
↪"exp-zh/encoder-epoch-99-avg-1.onnx", decoder_filename="exp-zh/decoder-epoch-99-avg-1.
↪onnx", joiner_filename="exp-zh/joiner-$poch-99-avg-1.onnx"),_
↪paraformer=OfflineParaformerModelConfig(model=""), nemo_
↪ctc=OfflineNemoEncDecCtcModelConfig(model=""), whisper=OfflineWhisperModelConfig
↪$encoder="", decoder="", language="", task="transcribe"),_
↪tdnn=OfflineTdnnModelConfig(model=""), tokens="exp-zh/tokens.txt", num_threads=2,_
↪debug=False, provider="cpu", model_type=""), lm_config=OfflineLMConfig(model="",_
↪scale=0.5), decoding_method="modified_beam_search", max_active$paths=4, hotwords_
↪file=hotwords_cn.txt, hotwords_score=2)
Creating recognizer ...
Started
Done!

exp-zh/test_wavs/3.wav
{"text":"","timestamps":"[0.00, 0.16, 0.64, 1.28, 1.64, 2.04, 2.60, 2.88, 3.20, 3.52, 3.
↪92, 4.40, 4.68, 5.12, 5.44, 6.36, $.96, 7.32]","tokens":["","","","","","","","","","","","","",
↪","","","","","","","","","",""]}

exp-zh/test_wavs/4.wav
{"text":"","timestamps":"[0.00, 0.12, 0.80, 1.36, 1.76, 2.08, 2.28, 2.68, 2.92, 3.16, 3.
↪44, 3.80]","tokens":["","","","","","","$",
",","","","","","",""]}

exp-zh/test_wavs/5.wav
{"text":"","timestamps":"[0.00, 0.12, 0.80, 1.24, 1.56, 1.96, 2.68, 3.08, 3.32]","tokens
↪":["","","","","","","","","","",""]}

exp-zh/test_wavs/6.wav
{"text":"","timestamps":"[0.00, 0.12, 0.80, 1.12, 1.44, 1.68, 1.92, 2.16, 2.36, 2.60, 2.
↪84, 3.12]","tokens":["","","","","","","$",
",","","","","","",""]}

num threads: 2
decoding method: modified_beam_search
max active paths: 4
Elapsed seconds: 1.810 s
Real time factor (RTF): 1.810 / 20.328 = 0.089

```

Hint: ->

->

->

->

---

## Python api

### Decoding without hotwords

```
python python-api-examples/offline-decode-files.py \
--encoder exp-zh/encoder-epoch-99-avg-1.onnx \
--decoder exp-zh/decoder-epoch-99-avg-1.onnx \
--joiner exp-zh/joiner-epoch-99-avg-1.onnx \
--tokens exp-zh/tokens.txt \
--decoding-method modified_beam_search \
exp-zh/test_wavs/3.wav exp-zh/test_wavs/4.wav exp-zh/test_wavs/5.wav exp-zh/test_wavs/6.
˓wav
```

The output is:

```
Started!
Done!
exp-zh/test_wavs/3.wav

-----
exp-zh/test_wavs/4.wav

-----
exp-zh/test_wavs/5.wav

-----
exp-zh/test_wavs/6.wav

-----
num_threads: 1
decoding_method: modified_beam_search
Wave duration: 20.328 s
Elapsed time: 2.653 s
Real time factor (RTF): 2.653/20.328 = 0.131
```

### Decoding with hotwords

```
python python-api-examples/offline-decode-files.py \
--encoder exp-zh/encoder-epoch-99-avg-1.onnx \
--decoder exp-zh/decoder-epoch-99-avg-1.onnx \
--joiner exp-zh/joiner-epoch-99-avg-1.onnx \
--tokens exp-zh/tokens.txt \
--decoding-method modified_beam_search \
--modeling-unit=cjkchar \
--hotwords-file hotwords_cn.txt \
--hotwords-score 2.0 \
exp-zh/test_wavs/3.wav exp-zh/test_wavs/4.wav exp-zh/test_wavs/5.wav exp-zh/test_wavs/6.wav
```

The output is:

```
Started!
Done!
exp-zh/test_wavs/3.wav

-----
exp-zh/test_wavs/4.wav

-----
exp-zh/test_wavs/5.wav

-----
exp-zh/test_wavs/6.wav

-----
num_threads: 1
decoding_method: modified_beam_search
Wave duration: 20.328 s
Elapsed time: 2.636 s
Real time factor (RTF): 2.636/20.328 = 0.130
```

**Hint:** ->

->  
->  
->

### Modeling unit is cjkchar+bpe

#### Download the model

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
˓→streaming-zipformer-bilingual-zh-en-2023-02-20.tar.bz2
tar xvf sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20.tar.bz2
rm sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20.tar.bz2

ln -s sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20 exp-mixed
```

Export bpe.vocab if you can't find bpe.vocab in the model directory.

```
python script/export_bpe_vocab.py --bpe-model exp/bpe.model
```

The hotwords\_mix.txt contains:

**C++ api****Decoding without hotwords**

```
./build/bin/sherpa-onnx \
  --encoder=exp-mixed/encoder-epoch-99-avg-1.onnx \
  --decoder=exp-mixed/decoder-epoch-99-avg-1.onnx \
  --joiner=exp-mixed/joiner-epoch-99-avg-1.onnx \
  --decoding-method=modified_beam_search \
  --tokens=exp-mixed/tokens.txt \
  exp-mixed/test_wavs/0.wav exp-mixed/test_wavs/2.wav
```

The output is:

```
/star-kw/kangwei/code/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./build/bin/
sherpa-onnx --encoder=exp-mixed/encoder-epoch-99-avg-1.onnx --decoder=exp-mixed/
decoder-epoch-99-avg-1.onnx --joiner=exp-mixed/joiner-epoch-99-avg-1.onnx --decoding-
method=modified_beam_search --tokens=exp-mixed/tokens.txt exp-mixed/test_wavs/0.wav
exp-mixed/test_wavs/2.wav

OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_
dim=80), model_config=OnlineModelConfig(transducer=OnlineTransducerModelConfig(encoder=
"exp-mixed/encoder-epoch-99-avg-1.onnx", decoder="exp-mixed/decoder-epoch-99-avg-1.onnx
", joiner="exp-mixed/joiner-epoch-99-avg-1.onnx"),_
paraformer=OnlineParaformerModelConfig(encoder="", decoder=""), tokens="exp-mixed/
tokens.txt", num_threads=1, debug=False, provider="cpu", model_type=""), lm_
config=OnlineLMConfig(model="", scale=0.5), endpoint_
config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_trailing_
silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_nonsilence=True,_
min_trailing_silence=1.2, min_utterance_length=0), rule3=EndpointRule(must_contain_
nonsilence=False, min_trailing_silence=0, min_utterance_length=20)), enable_
endpoint=True, max_active_paths=4, hotwords_score=1.5, hotwords_file="", decoding_
method="modified_beam_search")

exp-mixed/test_wavs/0.wav
Elapsed seconds: 3, Real time factor (RTF): 0.3
MONDAY TODAY IS LIBR THE DAY AFTER TOMORROW
{"is_final":false,"segment":0,"start_time":0.0,"text":" MONDAY TODAY IS LIBR THE DAY_
AFTER TOMORROW","timestamps":[0.64, 1.04, 1.60, 2.08, 2.20, 2.40, 4.16, 4.40, 4.88, 5.
56, 5.80, 6.16, 6.84, 7.12, 7.44, 8.04, 8.16, 8.24, 8.28, 9.04, 9.40, 9.64, 9.88],"_
"tokens":["","","","","MO","N","DAY","TO","DAY","IS","LI","B","R","THE","DAY","_
AFTER","TO","M","OR","ROW","","","","","",""]}

exp-mixed/test_wavs/2.wav
Elapsed seconds: 1.7, Real time factor (RTF): 0.37
FREQUENTLY
{"is_final":false,"segment":0,"start_time":0.0,"text":" FREQUENTLY","timestamps":[0.00,_
0.40, 0.52, 0.96, 1.08, 1.28, 1.48, 1.68, 1.84, 2.00, 2.24, 2.36, 2.52, 2.68, 2.92, 3.
00, 3.12, 3.32, 3.64, 3.96, 4.36],"tokens":["","","","","","","","","","","","","","","","F
","RE","QU","ENT","LY","","","",""]}
```

**Decoding with hotwords**

```
./build/bin/sherpa-onnx \
```

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```
--encoder=exp-mixed/encoder-epoch-99-avg-1.onnx \
--decoder=exp-mixed/decoder-epoch-99-avg-1.onnx \
--joiner=exp-mixed/joiner-epoch-99-avg-1.onnx \
--decoding-method=modified_beam_search \
--tokens=exp-mixed/tokens.txt \
--modeling-unit=cjkchar+bpe \
--bpe-vocab=exp/bpe.vocab \
--hotwords-file=hotwords_mix.txt \
--hotwords-score=2.0 \
exp-mixed/test_wavs/0.wav exp-mixed/test_wavs/2.wav
```

The output is:

```
./build/bin/sherpa-ONNX --encoder=exp-mixed/encoder-epoch-99-avg-1.onnx --decoder=exp-mixed/decoder-epoch-99-avg-1.onnx --joiner=exp-mixed/joiner-epoch-99-avg-1.onnx --decoding-method=modified_beam_search --tokens=exp-mixed/tokens.txt --tokens-type=cjkchar+bpe --bpe-model=exp-mixed/bpe.model --hotwords-file=hotwords_mix.txt --hotwords-score=2.0 --exp-mixed/test_wavs/0.wav exp-mixed/test_wavs/2.wav

OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_dim=80), model_config=OnlineModelConfig(transducer=OnlineTransducerModelConfig(encoder="exp-mixed/encoder-epoch-99-avg-1.onnx", decoder="exp-mixed/decoder-epoch-99-avg-1.onnx", joiner="exp-mixed/joiner-epoch-99-avg-1.onnx"), paraformer=OnlineParaformerModelConfig(encoder="", decoder=""), tokens="exp-mixed/tokens.txt", num_threads=1, debug=False, provider="cpu", model_type=""), lm_config=OnlineLMConfig(model="", scale=0.5), endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_trailing_silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_nonsilence=True, min_trailing_silence=1.2, min_utterance_length=0), rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_silence=0, min_utterance_length=20)), enable_endpoint=True, max_active_paths=4, hotwords_score=2, hotwords_file="hotwords_mix.txt", decoding_method="modified_beam_search"))

exp-mixed/test_wavs/0.wav
Elapsed seconds: 3.2, Real time factor (RTF): 0.32
MONDAY TODAY IS THE DAY AFTER TOMORROW
{"is_final":false,"segment":0,"start_time":0.0,"text":" MONDAY TODAY IS THE DAY AFTER", "timestamps": "[0.64, 1.04, 1.60, 2.08, 2.20, 2.40, 4.16, 4.40, 4.88, 5.56, 5.68, 6.00, 6.84, 7.12, 7.44, 8.04, 8.16, 8.24, 8.28, 9.04, 9.40, 9.64, 9.88]", "tokens": ["", "", "", " MO", "N", "DAY", " TO", "DAY", " IS", "", "", " THE", " DAY", " AFTER", " TO", "M", "OR", "ROW", "", "", "", "" ]}

exp-mixed/test_wavs/2.wav
Elapsed seconds: 1.9, Real time factor (RTF): 0.4
FREQUENTLY
{"is_final":false,"segment":0,"start_time":0.0,"text":" FREQUENTLY", "timestamps": "[0.00, 0.40, 0.52, 0.96, 1.08, 1.28, 1.48, 1.68, 1.84, 2.00, 2.24, 2.36, 2.52, 2.68, 2.92, 3.00, 3.12, 3.32, 3.64, 3.96, 4.36]", "tokens": ["", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", " F", "RE", "QU", "ENT", "LY", "", "", "" ]}
```

Hint: LIBR ->

->

---

## Python api

### Decoding without hotwords

```
python python-api-examples/online-decode-files.py \
--encoderexp-mixed/encoder-epoch-99-avg-1.onnx \
--decoder exp-mixed/decoder-epoch-99-avg-1.onnx \
--joiner exp-mixed/joiner-epoch-99-avg-1.onnx \
--decoding-method modified_beam_search \
--tokens exp-mixed/tokens.txt
exp-mixed/test_wavs/0.wav exp-mixed/test_wavs/2.wav
```

The output is:

```
Started!
Done!
exp-mixed/test_wavs/0.wav
MONDAY TODAY IS LIBR THE DAY AFTER TOMORROW
-----
exp-mixed/test_wavs/2.wav
FREQUENTLY
-----
num_threads: 1
decoding_method: modified_beam_search
Wave duration: 14.743 s
Elapsed time: 3.052 s
Real time factor (RTF): 3.052/14.743 = 0.207
```

### Decoding with hotwords

```
python python-api-examples/online-decode-files.py \
--encoder exp-mixed/encoder-epoch-99-avg-1.onnx \
--decoder exp-mixed/decoder-epoch-99-avg-1.onnx \
--joiner exp-mixed/joiner-epoch-99-avg-1.onnx \
--decoding-method modified_beam_search \
--tokens exp-mixed/tokens.txt \
--modeling-unit cjkchar+bpe \
--bpe-vocab exp-mixed/bpe.vocab \
--hotwords-file hotwords_mix.txt \
--hotwords-score 2.0 \
exp-mixed/test_wavs/0.wav exp-mixed/test_wavs/2.wav
```

The output is:

```
Started!
Done!
exp-mixed/test_wavs/0.wav
MONDAY TODAY IS THE DAY AFTER TOMORROW
-----
exp-mixed/test_wavs/2.wav
```

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FREQUENTLY

```
-----
num_threads: 1
decoding_method: modified_beam_search
Wave duration: 14.743 s
Elapsed time: 3.060 s
Real time factor (RTF): 3.060/14.743 = 0.208
```

**Hint:** LIBR ->

-&gt;

## 8.17 Keyword spotting

In this section, we describe how we implement the open vocabulary keyword spotting (aka customized keyword spotting) feature and how to use it in `sherpa-onnx`.

### 8.17.1 What is open vocabulary keyword spotting

Basically, an open vocabulary keyword spotting system is just like a tiny ASR system, but it can only decode words/phrases in the given keywords. For example, if the given keyword is HELLO WORLD, then the decoded result should be either HELLO WORLD or empty. As for open vocabulary (or customized), it means you can specify any keywords without re-training the model. For building a conventional keyword spotting systems, people need to prepare a lot of audio-text pairs for the selected keywords and the trained model can only be used to detect those selected keywords. While an open vocabulary keyword spotting system allows people using one system to detect different keywords, even the keywords might not be in the training data.

### 8.17.2 Decoder for open vocabulary keyword spotting

For now, we only implement a beam search decoder to make the system only trigger the given keywords (i.e. the model itself is actually a tiny ASR). To make it is able to balance between the triggered rate and false alarm, we introduce two parameters for each keyword, `boosting score` and `trigger threshold`. The `boosting score` works like the hotwords recognition, it help the paths containing keywords to survive beam search, the larger this score is the easier the corresponding keyword will be triggered, read [Hotwords \(Contextual biasing\)](#) for more details. The `trigger threshold` defines the minimum acoustic probability of decoded sequences (token sequences) that can be triggered, it is a float value between 0 to 1, the lower this threshold is the easier the corresponding keyword will be triggered.

### 8.17.3 Keywords file

The input keywords looks like (the keywords are HELLO WORLD, HI GOOGLE and HEY SIRI):

```
HE LL O WORLD :1.5 #0.35
HI GO O G LE :1.0 #0.25
HE Y S I RI
```

Each line contains a keyword, the first several tokens (separated by spaces) are encoded tokens of the keyword, the item starts with : is the **boosting score** and the item starts with # is the **trigger threshold**. Note: No spaces between : (or #) and the float value.

To get the tokens you need to use the command line tool in `sherpa-onnx` to convert the original keywords, you can see the usage as follows:

```
sherpa-onnx-cli text2token --help
Usage: sherpa-onnx-cli text2token [OPTIONS] INPUT OUTPUT

Options:

  --text TEXT          Path to the input texts. Each line in the texts contains the
  ↵original phrase, it might also contain some extra items,
  ↵for example, the boosting score (startting with :), the triggering
  ↵threshold
  ↵(startting with #, only used in keyword spotting task) and the
  ↵original phrase (startting with @).
  ↵Note: extra items will be kept in the output.

  example input 1 (tokens_type = ppinyin):
  ↵:2.0 #0.6 @
  ↵:3.5 @
  ↵#0.6 @
  example output 1:
  ↵x iǎo ài tóng x ué :2.0 #0.6 @
  ↵n ī h āo w èn w èn :3.5 @
  ↵x iǎo y ī x iǎo y ī #0.6 @

  example input 2 (tokens_type = bpe):
  ↵HELLO WORLD :1.5 #0.4
  ↵HI GOOGLE :2.0 #0.8
  ↵HEY SIRI #0.35
  example output 2:
  ↵HE LL O WORLD :1.5 #0.4
  ↵HI GO O G LE :2.0 #0.8
  ↵HE Y S I RI #0.35

  --tokens TEXT          The path to tokens.txt.
  --tokens-type TEXT    The type of modeling units, should be cjkchar, bpe, cjkchar+bpe,
  ↵fpinyin or ppinyin.
  ↵fpinyin means full pinyin, each cjkchar has a pinyin(with tone).
  ↵ppinyin
  ↵means partial pinyin, it splits pinyin into initial and final,
  --bpe-model TEXT     The path to bpe.model. Only required when tokens-type is bpe or
  ↵cjkchar+bpe.
```

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--help	Show this message and exit.
--------	-----------------------------

---

**Note:** If the tokens-type is fpinyin or ppinyin, you MUST provide the original keyword (starting with @).

---

**Note:** If you install sherpa-onnx from sources (i.e. not by pip), you can use the alternative script in *scripts*, the usage is almost the same as the command line tool, read the help information by:

python3 scripts/text2token.py --help
--------------------------------------

#### 8.17.4 How to use keyword spotting in sherpa-onnx

Currently, we provide command-line tool and android app for keyword spotting.

##### command-line tool

After installing `sherpa-onnx`, type `sherpa-onnx-keyword-spotter --help` for the help message.

#### 8.17.5 Android application

You can find pre-built Android APKs for keyword spotting at

<https://k2-fsa.github.io/sherpa/onnx/kws/apk.html>

Here is a demo video (Note: It is in Chinese).

#### 8.17.6 Pretrained models

You can find the pre-trained models in `sherpa-onnx-kws-pre-trained-models`.

### 8.18 Punctuation

This section introduces the models that `sherpa-onnx` supports for adding punctuations to text.

---

**Hint:** After getting text from speech using speech-to-text, you can use models from this section to add punctuations to text.

---

### 8.18.1 Pre-trained models

This section lists pre-trained models for adding punctuations to text.

You can find all models at the following URL:

<https://github.com/k2-fsa/sherpa-onnx/releases/tag/punctuation-models>

#### sherpa-onnx-punct-ct-transformer-zh-en-vocab272727-2024-04-12

This model is converted from

[https://modelscope.cn/models/iic/punc\\_ct-transformer\\_zh-cn-common-vocab272727-pytorch/summary](https://modelscope.cn/models/iic/punc_ct-transformer_zh-cn-common-vocab272727-pytorch/summary)

and it supports both Chinese and English.

---

**Hint:** If you want to know how the model is converted to `sherpa-onnx`, please download it and you can find related scripts in the downloaded model directory.

---

In the following, we describe how to download and use it with `sherpa-onnx`.

#### Download the model

Please use the following commands to download it:

```
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/punctuation-models/sherpa-
→onnx-punct-ct-transformer-zh-en-vocab272727-2024-04-12.tar.bz2

# For Chinese users, you can also use the following mirror:
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/punctuation-models/
→sherpa-onnx-punct-ct-transformer-zh-en-vocab272727-2024-04-12.tar.bz2

tar xvf sherpa-onnx-punct-ct-transformer-zh-en-vocab272727-2024-04-12.tar.bz2
rm sherpa-onnx-punct-ct-transformer-zh-en-vocab272727-2024-04-12.tar.bz2
```

You will find the following files after unzipping:

```
-rw-r--r-- 1 fangjun staff  1.4K Apr 12 12:32 README.md
-rw-r--r-- 1 fangjun staff  1.6K Apr 12 14:40 add-model-metadata.py
-rw-r--r-- 1 fangjun staff  810B Apr 12 11:56 config.yaml
-rw-r--r-- 1 fangjun staff   42B Apr 12 11:45 configuration.json
-rw-r--r-- 1 fangjun staff  281M Apr 12 14:40 model.onnx
-rw-r--r-- 1 fangjun staff  745B Apr 12 11:53 show-model-input-output.py
-rw-r--r-- 1 fangjun staff  4.9K Apr 13 18:45 test.py
-rw-r--r-- 1 fangjun staff  4.0M Apr 12 11:56 tokens.json
```

Only `model.onnx` is needed in `sherpa-onnx`. All other files are for your information about how the model is converted to `sherpa-onnx`.

## C++ binary examples

After installing `sherpa-onnx`, you can use the following command to add punctuations to text:

```
./bin/sherpa-onnx-offline-punctuation \
--ct-transformer=./sherpa-onnx-punct-ct-transformer-zh-en-vocab272727-2024-04-12/model.
˓→onnx \
"!"
```

The output is given below:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./bin/
˓→sherpa-onnx-offline-punctuation --ct-transformer=./sherpa-onnx-punct-ct-transformer-zh-
˓→en-vocab272727-2024-04-12/model.onnx ''
```

```
OfflinePunctuationConfig(model=OfflinePunctuationModelConfig(ct_transformer=".sherpa-
˓→onnx-punct-ct-transformer-zh-en-vocab272727-2024-04-12/model.onnx", num_threads=1,
˓→debug=False, provider="cpu"))
Creating OfflinePunctuation ...
Started
Done
Num threads: 1
Elapsed seconds: 0.007 s
Input text:
Output text:
```

The second example is for text containing both Chinese and English:

```
./bin/sherpa-onnx-offline-punctuation \
--ct-transformer=./sherpa-onnx-punct-ct-transformer-zh-en-vocab272727-2024-04-12/model.
˓→onnx \
"How are youthank you are you ok"
```

Its output is given below:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./bin/
˓→sherpa-onnx-offline-punctuation --ct-transformer=./sherpa-onnx-punct-ct-transformer-zh-
˓→en-vocab272727-2024-04-12/model.onnx 'How are youthank you are you ok'

OfflinePunctuationConfig(model=OfflinePunctuationModelConfig(ct_transformer=".sherpa-
˓→onnx-punct-ct-transformer-zh-en-vocab272727-2024-04-12/model.onnx", num_threads=1,
˓→debug=False, provider="cpu"))
Creating OfflinePunctuation ...
Started
Done
Num threads: 1
Elapsed seconds: 0.005 s
Input text: How are youthank you are you ok
Output text: How are youthank youare you ok
```

The last example is for text containing only English:

```
./bin/sherpa-onnx-offline-punctuation \
--ct-transformer=./sherpa-onnx-punct-ct-transformer-zh-en-vocab272727-2024-04-12/model.
˓→onnx \
```

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```
"The African blogosphere is rapidly expanding bringing more voices online in the form  
of commentaries opinions analyses rants and poetry"
```

Its output is given below:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./bin/  
sherpa-onnx-offline-punctuation --ct-transformer=./sherpa-onnx-punct-ct-transformer-zh-  
en-vocab272727-2024-04-12/model.onnx 'The African blogosphere is rapidly expanding,  
bringing more voices online in the form of commentaries opinions analyses rants and  
poetry'  
  
OfflinePunctuationConfig(model=OfflinePunctuationModelConfig(ct_transformer=".sherpa-  
onnx-punct-ct-transformer-zh-en-vocab272727-2024-04-12/model.onnx", num_threads=1,  
debug=False, provider="cpu"))  
Creating OfflinePunctuation ...  
Started  
Done  
Num threads: 1  
Elapsed seconds: 0.003 s  
Input text: The African blogosphere is rapidly expanding bringing more voices online in  
the form of commentaries opinions analyses rants and poetry  
Output text: The African blogosphere is rapidly expanding bringing more voices online in  
the form of commentaries opinions analyses rants and poetry
```

## Python API examples

Please see

<https://github.com/k2-fsa/sherpa-onnx/blob/master/python-api-examples/add-punctuation.py>

## Huggingface space examples

Please see

- <https://huggingface.co/spaces/k2-fsa/generate-subtitles-for-videos>
- <https://huggingface.co/spaces/k2-fsa/automatic-speech-recognition>

---

**Hint:** For Chinese users, please visit the following mirrors:

- <https://hf-mirror.com/spaces/k2-fsa/generate-subtitles-for-videos>
  - <https://hf-mirror.com/spaces/k2-fsa/automatic-speech-recognition>
-

## Video demos

The following [video](#) is in Chinese.

## 8.19 Audio tagging

This section introduces the models that [sherpa-onnx](#) supports for audio tagging, which aims to recognize sound events within an audio clip without its temporal localization.

### 8.19.1 Pre-trained models

This section lists pre-trained models for audio tagging.

You can find all models at the following URL:

<https://github.com/k2-fsa/sherpa-onnx/releases/tag/audio-tagging-models>

#### sherpa-onnx-zipformer-small-audio-tagging-2024-04-15

This model is trained by <https://github.com/k2-fsa/icefall/pull/1421> using the dataset [audioset](#).

In the following, we describe how to download and use it with [sherpa-onnx](#).

#### Download the model

Please use the following commands to download it:

```
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/audio-tagging-models/sherpa-
˓→onnx-zipformer-small-audio-tagging-2024-04-15.tar.bz2

# For Chinese users, you can also use the following mirror:
wget https://hub.nuua.cf/k2-fsa/sherpa-onnx/releases/download/audio-tagging-models/
˓→sherpa-onnx-zipformer-small-audio-tagging-2024-04-15.tar.bz2

tar xvf sherpa-onnx-zipformer-small-audio-tagging-2024-04-15.tar.bz2
rm sherpa-onnx-zipformer-small-audio-tagging-2024-04-15.tar.bz2
```

You will find the following files after unzipping:

-rw-r--r--	1	fangjun	staff	243B	Apr 15 16:14	README.md
-rw-r--r--	1	fangjun	staff	14K	Apr 15 16:14	class_labels_indices.csv
-rw-r--r--	1	fangjun	staff	26M	Apr 15 16:14	model.int8.onnx
-rw-r--r--	1	fangjun	staff	88M	Apr 15 16:14	model.onnx
drwxr-xr-x	15	fangjun	staff	480B	Apr 15 16:14	test_wavs

## C++ binary examples

---

**Hint:** You can find the binary executable file `sherpa-onnx-offline-audio-tagging` after installing `sherpa-onnx` either from source or using `pip install sherpa-onnx`.

---

### Cat

For the following test wave,

the command:

```
./bin/sherpa-onnx-offline-audio-tagging \
--zipformer-model=./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/model.int8.
˓→onnx \
--labels=./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/class_labels_indices.
˓→csv \
./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/test_wavs/1.wav
```

prints the following:

```
0: AudioEvent(name="Animal", index=72, prob=0.947886)
1: AudioEvent(name="Cat", index=81, prob=0.938876)
2: AudioEvent(name="Domestic animals, pets", index=73, prob=0.931975)
3: AudioEvent(name="Caterwaul", index=85, prob=0.178876)
4: AudioEvent(name="Meow", index=83, prob=0.176177)
Num threads: 1
Wave duration: 10.000
Elapsed seconds: 0.297 s
Real time factor (RTF): 0.297 / 10.000 = 0.030
```

---

**Hint:** By default, it outputs the top 5 events. The first event has the largest probability.

---

### Whistle

For the following test wave,

the command:

```
./bin/sherpa-onnx-offline-audio-tagging \
--zipformer-model=./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/model.int8.
˓→onnx \
--labels=./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/class_labels_indices.
˓→csv \
./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/test_wavs/2.wav
```

prints the following:

```

0: AudioEvent(name="Whistling", index=40, prob=0.804928)
1: AudioEvent(name="Music", index=137, prob=0.27548)
2: AudioEvent(name="Piano", index=153, prob=0.135418)
3: AudioEvent(name="Keyboard (musical)", index=152, prob=0.0580414)
4: AudioEvent(name="Musical instrument", index=138, prob=0.0400399)
Num threads: 1
Wave duration: 10.000
Elapsed seconds: 0.289 s
Real time factor (RTF): 0.289 / 10.000 = 0.029

```

## Music

For the following test wave,

the command:

```

./bin/sherpa-onnx-offline-audio-tagging \
--zipformer-model=./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/model.int8.
˓→onnx \
--labels=./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/class_labels_indices.
˓→csv \
./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/test_wavs/3.wav

```

prints the following:

```

0: AudioEvent(name="Music", index=137, prob=0.79673)
1: AudioEvent(name="A capella", index=255, prob=0.765521)
2: AudioEvent(name="Singing", index=27, prob=0.473899)
3: AudioEvent(name="Vocal music", index=254, prob=0.459337)
4: AudioEvent(name="Choir", index=28, prob=0.458174)
Num threads: 1
Wave duration: 10.000
Elapsed seconds: 0.279 s
Real time factor (RTF): 0.279 / 10.000 = 0.028

```

## Laughter

For the following test wave,

the command:

```

./bin/sherpa-onnx-offline-audio-tagging \
--zipformer-model=./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/model.int8.
˓→onnx \
--labels=./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/class_labels_indices.
˓→csv \
./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/test_wavs/4.wav

```

prints the following:

```
0: AudioEvent(name="Laughter", index=16, prob=0.929239)
1: AudioEvent(name="Snicker", index=19, prob=0.321969)
2: AudioEvent(name="Giggle", index=18, prob=0.149667)
3: AudioEvent(name="Inside, small room", index=506, prob=0.119332)
4: AudioEvent(name="Belly laugh", index=20, prob=0.100728)
Num threads: 1
Wave duration: 10.000
Elapsed seconds: 0.314 s
Real time factor (RTF): 0.314 / 10.000 = 0.031
```

## Finger snapping

For the following test wave,

the command:

```
./bin/sherpa-onnx-offline-audio-tagging \
--zipformer-model=./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/model.int8.
˓→onnx \
--labels=./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/class_labels_indices.
˓→csv \
./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/test_wavs/5.wav
```

prints the following:

```
0: AudioEvent(name="Finger snapping", index=62, prob=0.690543)
1: AudioEvent(name="Slap, smack", index=467, prob=0.452133)
2: AudioEvent(name="Clapping", index=63, prob=0.179213)
3: AudioEvent(name="Sound effect", index=504, prob=0.101151)
4: AudioEvent(name="Whack, thwack", index=468, prob=0.0294559)
Num threads: 1
Wave duration: 8.284
Elapsed seconds: 0.225 s
Real time factor (RTF): 0.225 / 8.284 = 0.027
```

## Baby cry

For the following test wave,

the command:

```
./bin/sherpa-onnx-offline-audio-tagging \
--zipformer-model=./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/model.int8.
˓→onnx \
--labels=./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/class_labels_indices.
˓→csv \
./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/test_wavs/6.wav
```

prints the following:

```

0: AudioEvent(name="Baby cry, infant cry", index=23, prob=0.912273)
1: AudioEvent(name="Crying, sobbing", index=22, prob=0.670927)
2: AudioEvent(name="Whimper", index=24, prob=0.187221)
3: AudioEvent(name="Inside, small room", index=506, prob=0.0314955)
4: AudioEvent(name="Sound effect", index=504, prob=0.0118726)
Num threads: 1
Wave duration: 8.719
Elapsed seconds: 0.232 s
Real time factor (RTF): 0.232 / 8.719 = 0.027

```

## Smoke alarm

For the following test wave,

the command:

```

./bin/sherpa-onnx-offline-audio-tagging \
--zipformer-model=./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/model.int8.
˓→onnx \
--labels=./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/class_labels_indices.
˓→csv \
./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/test_wavs/7.wav

```

prints the following:

```

0: AudioEvent(name="Smoke detector, smoke alarm", index=399, prob=0.781478)
1: AudioEvent(name="Beep, bleep", index=481, prob=0.641056)
2: AudioEvent(name="Buzzer", index=398, prob=0.218576)
3: AudioEvent(name="Fire alarm", index=400, prob=0.140145)
4: AudioEvent(name="Alarm", index=388, prob=0.012525)
Num threads: 1
Wave duration: 2.819
Elapsed seconds: 0.080 s
Real time factor (RTF): 0.080 / 2.819 = 0.028

```

## Siren

For the following test wave,

the command:

```

./bin/sherpa-onnx-offline-audio-tagging \
--zipformer-model=./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/model.int8.
˓→onnx \
--labels=./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/class_labels_indices.
˓→csv \
./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/test_wavs/8.wav

```

prints the following:

```
0: AudioEvent(name="Siren", index=396, prob=0.877108)
1: AudioEvent(name="Civil defense siren", index=397, prob=0.732789)
2: AudioEvent(name="Vehicle", index=300, prob=0.0113797)
3: AudioEvent(name="Inside, small room", index=506, prob=0.00537381)
4: AudioEvent(name="Outside, urban or manmade", index=509, prob=0.00261939)
Num threads: 1
Wave duration: 7.721
Elapsed seconds: 0.220 s
Real time factor (RTF): 0.220 / 7.721 = 0.028
```

## Stream water

For the following test wave,

the command:

```
./bin/sherpa-onnx-offline-audio-tagging \
--zipformer-model=./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/model.int8.
˓→onnx \
--labels=./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/class_labels_indices.
˓→csv \
./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/test_wavs/10.wav
```

prints the following:

```
0: AudioEvent(name="Stream", index=292, prob=0.247785)
1: AudioEvent(name="Water", index=288, prob=0.231587)
2: AudioEvent(name="Gurgling", index=297, prob=0.170981)
3: AudioEvent(name="Trickle, dribble", index=450, prob=0.108859)
4: AudioEvent(name="Liquid", index=444, prob=0.0693812)
Num threads: 1
Wave duration: 7.837
Elapsed seconds: 0.212 s
Real time factor (RTF): 0.212 / 7.837 = 0.027
```

## Meow

For the following test wave,

the command:

```
./bin/sherpa-onnx-offline-audio-tagging \
--zipformer-model=./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/model.int8.
˓→onnx \
--labels=./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/class_labels_indices.
˓→csv \
./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/test_wavs/11.wav
```

prints the following:

```

0: AudioEvent(name="Meow", index=83, prob=0.814944)
1: AudioEvent(name="Cat", index=81, prob=0.698858)
2: AudioEvent(name="Domestic animals, pets", index=73, prob=0.564516)
3: AudioEvent(name="Animal", index=72, prob=0.535303)
4: AudioEvent(name="Music", index=137, prob=0.105332)
Num threads: 1
Wave duration: 11.483
Elapsed seconds: 0.361 s
Real time factor (RTF): 0.361 / 11.483 = 0.031

```

## Dog bark

For the following test wave,

the command:

```

./bin/sherpa-onnx-offline-audio-tagging \
--zipformer-model=./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/model.int8.
˓→onnx \
--labels=./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/class_labels_indices.
˓→csv \
./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/test_wavs/12.wav

```

prints the following:

```

0: AudioEvent(name="Animal", index=72, prob=0.688237)
1: AudioEvent(name="Dog", index=74, prob=0.637803)
2: AudioEvent(name="Bark", index=75, prob=0.608597)
3: AudioEvent(name="Bow-wow", index=78, prob=0.515501)
4: AudioEvent(name="Domestic animals, pets", index=73, prob=0.495074)
Num threads: 1
Wave duration: 8.974
Elapsed seconds: 0.261 s
Real time factor (RTF): 0.261 / 8.974 = 0.029

```

## Oink (pig)

For the following test wave,

the command:

```

./bin/sherpa-onnx-offline-audio-tagging \
--zipformer-model=./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/model.int8.
˓→onnx \
--labels=./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/class_labels_indices.
˓→csv \
./sherpa-onnx-zipformer-small-audio-tagging-2024-04-15/test_wavs/13.wav

```

prints the following:

```
0: AudioEvent(name="Oink", index=94, prob=0.888416)
1: AudioEvent(name="Pig", index=93, prob=0.164295)
2: AudioEvent(name="Animal", index=72, prob=0.160802)
3: AudioEvent(name="Speech", index=0, prob=0.0276513)
4: AudioEvent(name="Snort", index=46, prob=0.0201952)
Num threads: 1
Wave duration: 9.067
Elapsed seconds: 0.261 s
Real time factor (RTF): 0.261 / 9.067 = 0.029
```

## Python API examples

Please see

<https://github.com/k2-fsa/sherpa-onnx/blob/master/python-api-examples/audio-tagging-from-a-file.py>

## Huggingface space

You can try audio tagging with `sherpa-onnx` from within your browser by visiting the following URL:

<https://huggingface.co/spaces/k2-fsa/audio-tagging>

---

**Note:** For Chinese users, please use

<https://hf-mirror.com/spaces/k2-fsa/audio-tagging>

---

## 8.19.2 Android

You can find Android APKs for each model at the following page

<https://k2-fsa.github.io/sherpa/onnx/audio-tagging/apk.html>

Please follow *Android* to build Android APKs from source.

If you want to run audio tagging on your WearOS watches, please see *WearOS*.

## 8.19.3 WearOS

You can find APKs for WearOS of each model at the following page

<https://k2-fsa.github.io/sherpa/onnx/audio-tagging/apk-wearos.html>

Please follow *Android* to build APKs for WearOS from source.

If you want to run audio tagging on your Android phones, please see *Android*.

## 8.20 Spoken language identification

This section describes how to use `sherpa-ONNX` for spoken language identification.

### 8.20.1 Pre-trained models

#### whisper

Currently, we support whisper multilingual models for spoken language identification.

Model type	Huggingface repo
<code>tiny</code>	<a href="https://huggingface.co/csukuangfj/sherpa-ONNX-whisper-tiny">https://huggingface.co/csukuangfj/sherpa-ONNX-whisper-tiny</a>
<code>base</code>	<a href="https://huggingface.co/csukuangfj/sherpa-ONNX-whisper-base">https://huggingface.co/csukuangfj/sherpa-ONNX-whisper-base</a>
<code>small</code>	<a href="https://huggingface.co/csukuangfj/sherpa-ONNX-whisper-small">https://huggingface.co/csukuangfj/sherpa-ONNX-whisper-small</a>
<code>medium</code>	<a href="https://huggingface.co/csukuangfj/sherpa-ONNX-whisper-medium">https://huggingface.co/csukuangfj/sherpa-ONNX-whisper-medium</a>

**Hint:** You can also download them from

<https://github.com/k2-fsa/sherpa-ONNX/releases/tag/asr-models>

In the following, we use the `tiny` model as an example. You can replace `tiny` with `base`, `small`, or `medium` and everything still holds.

#### Download the model

Please use the following commands to download the `tiny` model:

```
wget https://github.com/k2-fsa/sherpa-ONNX/releases/download/asr-models/sherpa-ONNX-
˓→whisper-tiny.tar.bz2

# For Chinese users, please use
# wget https://hub.nuaa.cf/k2-fsa/sherpa-ONNX/releases/download/asr-models/sherpa-ONNX-
˓→whisper-tiny.tar.bz2

tar xvf sherpa-ONNX-whisper-tiny.tar.bz2
rm sherpa-ONNX-whisper-tiny.tar.bz2
```

You should find the following files after unzipping:

```
-rw-r--r-- 1 fangjun staff 427B Jan 31 16:21 README.md
-rwxr-xr-x 1 fangjun staff 19K Jan 31 16:21 export-ONNX.py
-rw-r--r-- 1 fangjun staff 15B Jan 31 16:21 requirements.txt
-rwxr-xr-x 1 fangjun staff 12K Jan 31 16:21 test.py
drwxr-xr-x 6 fangjun staff 192B Jan 31 16:22 test_wavs
-rw-r--r-- 1 fangjun staff 86M Jan 31 16:22 tiny-decoder.int8.ONNX
-rw-r--r-- 1 fangjun staff 109M Jan 31 16:22 tiny-decoder.ONNX
-rw-r--r-- 1 fangjun staff 12M Jan 31 16:22 tiny-encoder.int8.ONNX
-rw-r--r-- 1 fangjun staff 36M Jan 31 16:22 tiny-encoder.ONNX
-rw-r--r-- 1 fangjun staff 798K Jan 31 16:22 tiny-tokens.txt
```

## Download test waves

Please use the following command to download test data:

```
wget https://github.com/k2-fsa/sherpa-onné/releases/download/asr-models/spoken-language-  
identification-test-wavs.tar.bz2  
  
# For Chinese users, please use the following mirror  
# wget https://hub.nuua.cf/k2-fsa/sherpa-onné/releases/download/asr-models/spoken-  
language-identification-test-wavs.tar.bz2  
  
tar xvf spoken-language-identification-test-wavs.tar.bz2  
rm spoken-language-identification-test-wavs.tar.bz2
```

You can find the following test files after unzipping:

```
-rw-r--r-- 1 fangjun staff 222K Mar 24 12:51 ar-arabic.wav  
-rw-r--r--@ 1 fangjun staff 137K Mar 24 13:09 bg-bulgarian.wav  
-rw-r--r-- 1 fangjun staff 83K Mar 24 13:07 cs-czech.wav  
-rw-r--r-- 1 fangjun staff 112K Mar 24 13:07 da-danish.wav  
-rw-r--r-- 1 fangjun staff 199K Mar 24 12:50 de-german.wav  
-rw-r--r-- 1 fangjun staff 207K Mar 24 13:06 el-greek.wav  
-rw-r--r-- 1 fangjun staff 31K Mar 24 12:45 en-english.wav  
-rw-r--r--@ 1 fangjun staff 77K Mar 24 12:23 es-spanish.wav  
-rw-r--r--@ 1 fangjun staff 371K Mar 24 12:21 fa-persian.wav  
-rw-r--r-- 1 fangjun staff 136K Mar 24 13:08 fi-finnish.wav  
-rw-r--r-- 1 fangjun staff 112K Mar 24 12:49 fr-french.wav  
-rw-r--r-- 1 fangjun staff 179K Mar 24 12:47 hi-hindi.wav  
-rw-r--r--@ 1 fangjun staff 177K Mar 24 12:29 hr-croatian.wav  
-rw-r--r-- 1 fangjun staff 167K Mar 24 12:53 id-indonesian.wav  
-rw-r--r-- 1 fangjun staff 136K Mar 24 12:54 it-italian.wav  
-rw-r--r-- 1 fangjun staff 46K Mar 24 12:44 ja-japanese.wav  
-rw-r--r--@ 1 fangjun staff 122K Mar 24 12:52 ko-korean.wav  
-rw-r--r-- 1 fangjun staff 85K Mar 24 12:54 nl-dutch.wav  
-rw-r--r--@ 1 fangjun staff 241K Mar 24 12:38 no-norwegian.wav  
-rw-r--r--@ 1 fangjun staff 121K Mar 24 12:35 po-polish.wav  
-rw-r--r-- 1 fangjun staff 166K Mar 24 12:48 pt-portuguese.wav  
-rw-r--r--@ 1 fangjun staff 144K Mar 24 12:33 ro-romanian.wav  
-rw-r--r-- 1 fangjun staff 111K Mar 24 12:51 ru-russian.wav  
-rw-r--r--@ 1 fangjun staff 239K Mar 24 12:40 sk-slovak.wav  
-rw-r--r-- 1 fangjun staff 196K Mar 24 13:01 sv-swedish.wav  
-rw-r--r-- 1 fangjun staff 106K Mar 24 13:14 ta-tamil.wav  
-rw-r--r-- 1 fangjun staff 104K Mar 24 13:02 tl-tagalog.wav  
-rw-r--r-- 1 fangjun staff 76K Mar 24 13:00 tr-turkish.wav  
-rw-r--r-- 1 fangjun staff 188K Mar 24 13:05 uk-ukrainian.wav  
-rw-r--r-- 1 fangjun staff 181K Mar 24 13:20 zh-chinese.wav
```

## Test with Python APIs

After installing `sherpa-onnx` either from source or from using `pip install sherpa-onnx`, you can run:

```
python3 ./python-api-examples/spoken-language-identification.py \
--whisper-encoder ./sherpa-onnx-whisper-tiny/tiny-encoder.int8.onnx \
--whisper-decoder ./sherpa-onnx-whisper-tiny/tiny-decoder.onnx \
./spoken-language-identification-test-wavs/de-german.wav
```

You should see the following output:

```
2024-04-17 15:53:23,104 INFO [spoken-language-identification.py:158] File: ./spoken-
language-identification-test-wavs/de-german.wav
2024-04-17 15:53:23,104 INFO [spoken-language-identification.py:159] Detected language: de
2024-04-17 15:53:23,104 INFO [spoken-language-identification.py:160] Elapsed seconds: 0.
275
2024-04-17 15:53:23,105 INFO [spoken-language-identification.py:161] Audio duration in
seconds: 6.374
2024-04-17 15:53:23,105 INFO [spoken-language-identification.py:162] RTF: 0.275/6.374 =
0.043
```

**Hint:** You can find `spoken-language-identification.py` at

<https://github.com/k2-fsa/sherpa-onnx/blob/master/python-api-examples/spoken-language-identification.py>

## Android APKs

You can find pre-built Android APKs for spoken language identification at the following address:

<https://k2-fsa.github.io/sherpa/onnx/spoken-language-identification/apk.html>

## Huggingface space

We provide a huggingface space for spoken language identification.

You can visit the following URL:

<http://huggingface.co/spaces/k2-fsa/spoken-language-identification>

**Note:** For Chinese users, you can use the following mirror:

<http://hf-mirror.com/spaces/k2-fsa/spoken-language-identification>

## 8.21 VAD

We support [silero-vad](#) for voice activity detection.

You can find pre-built Android APKs for VAD at:

<https://k2-fsa.github.io/sherpa/onnx/vad/apk.html>

APKs for VAD + speech recognition can be found at:

<https://k2-fsa.github.io/sherpa/onnx/vad/apk-asr.html>

## 8.22 Pre-trained models

The following table lists links for all pre-trained models.

Description	URL
Speech recognition (speech to text, ASR)	<a href="https://github.com/k2-fsa/sherpa-onnx/releases/tag/asr-models">https://github.com/k2-fsa/sherpa-onnx/releases/tag/asr-models</a>
Text to speech (TTS)	<a href="https://github.com/k2-fsa/sherpa-onnx/releases/tag/tts-models">https://github.com/k2-fsa/sherpa-onnx/releases/tag/tts-models</a>
VAD	<a href="https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/silero_vad.onnx">https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/silero_vad.onnx</a>
Keyword spotting	<a href="https://github.com/k2-fsa/sherpa-onnx/releases/tag/kws-models">https://github.com/k2-fsa/sherpa-onnx/releases/tag/kws-models</a>
Speech identification (Speaker ID)	<a href="https://github.com/k2-fsa/sherpa-onnx/releases/tag/speaker-recognition-models">https://github.com/k2-fsa/sherpa-onnx/releases/tag/speaker-recognition-models</a>
Spoken language identification (Language ID)	<a href="https://github.com/k2-fsa/sherpa-onnx/releases/tag/asr-models">https://github.com/k2-fsa/sherpa-onnx/releases/tag/asr-models</a> (multilingual whisper)
Audio tagging	<a href="https://github.com/k2-fsa/sherpa-onnx/releases/tag/audio-tagging-models">https://github.com/k2-fsa/sherpa-onnx/releases/tag/audio-tagging-models</a>
Punctuation	<a href="https://github.com/k2-fsa/sherpa-onnx/releases/tag/punctuation-models">https://github.com/k2-fsa/sherpa-onnx/releases/tag/punctuation-models</a>

In this section, we describe how to download and use all available pre-trained models for speech recognition.

---

**Hint:** Please install [git-lfs](#) before you continue.

Otherwise, you will be SAD later.

---

### 8.22.1 Online transducer models

This section lists available online transducer models.

## Zipformer-transducer-based Models

**Hint:** Please refer to [Installation](#) to install `sherpa-onnx` before you read this section.

### sherpa-onnx-streaming-zipformer-korean-2024-06-16 (Korean)

Training code for this model can be found at <https://github.com/k2-fsa/icefall/pull/1651>. It supports only Korean.

PyTorch checkpoint with optimizer state can be found at <https://huggingface.co/johnBamma/icefall-asr-k sponspeech-pruned-transducer-stateless7-streaming-2024-06-12>

In the following, we describe how to download it and use it with `sherpa-onnx`.

#### Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
˓→streaming-zipformer-korean-2024-06-16.tar.bz2

# For Chinese users, you can use the following mirror
# wget https://hub.nuua.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
˓→streaming-zipformer-korean-2024-06-16.tar.bz2

tar xvf sherpa-onnx-streaming-zipformer-korean-2024-06-16.tar.bz2
rm sherpa-onnx-streaming-zipformer-korean-2024-06-16.tar.bz2
ls -lh sherpa-onnx-streaming-zipformer-korean-2024-06-16
```

The output is given below:

```
$ ls -lh sherpa-onnx-streaming-zipformer-korean-2024-06-16

total 907104
-rw-r--r-- 1 fangjun staff  307K Jun 16 17:36 bpe.model
-rw-r--r-- 1 fangjun staff  2.7M Jun 16 17:36 decoder-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 fangjun staff  11M Jun 16 17:36 decoder-epoch-99-avg-1.onnx
-rw-r--r-- 1 fangjun staff 121M Jun 16 17:36 encoder-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 fangjun staff 279M Jun 16 17:36 encoder-epoch-99-avg-1.onnx
-rw-r--r-- 1 fangjun staff  2.5M Jun 16 17:36 joiner-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 fangjun staff  9.8M Jun 16 17:36 joiner-epoch-99-avg-1.onnx
drwxr-xr-x 7 fangjun staff 224B Jun 16 17:36 test_wavs
-rw-r--r-- 1 fangjun staff   59K Jun 16 17:36 tokens.txt
```

## Decode a single wave file

---

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

---

### fp32

The following code shows how to use fp32 models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
--tokens=./sherpa-onnx-streaming-zipformer-korean-2024-06-16/tokens.txt \
--encoder=./sherpa-onnx-streaming-zipformer-korean-2024-06-16/encoder-epoch-99-avg-1.\
onnx \
--decoder=./sherpa-onnx-streaming-zipformer-korean-2024-06-16/decoder-epoch-99-avg-1.\
onnx \
--joiner=./sherpa-onnx-streaming-zipformer-korean-2024-06-16/joiner-epoch-99-avg-1.\
onnx \
./sherpa-onnx-streaming-zipformer-korean-2024-06-16/test_wavs/0.wav
```

---

**Note:** Please use `./build/bin/Release/sherpa-onnx.exe` for Windows.

---

**Caution:** If you use Windows and get encoding issues, please run:

CHCP 65001

in your commandline.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./
build/bin/sherpa-onnx --tokens=./sherpa-onnx-streaming-zipformer-korean-2024-06-16/
tokens.txt --encoder=./sherpa-onnx-streaming-zipformer-korean-2024-06-16/encoder-epoch-
99-avg-1.onnx --decoder=./sherpa-onnx-streaming-zipformer-korean-2024-06-16/decoder-
epoch-99-avg-1.onnx --joiner=./sherpa-onnx-streaming-zipformer-korean-2024-06-16/
joiner-epoch-99-avg-1.onnx ./sherpa-onnx-streaming-zipformer-korean-2024-06-16/test-
wavs/0.wav

OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_
dim=80, low_freq=20, high_freq=400, dither=0), model_
config=OnlineModelConfig(transducer=OnlineTransducerModelConfig(encoder="./sherpa-onnx-
streaming-zipformer-korean-2024-06-16/encoder-epoch-99-avg-1.onnx", decoder="./sherpa-
onnx-streaming-zipformer-korean-2024-06-16/decoder-epoch-99-avg-1.onnx", joiner="./
sherpa-onnx-streaming-zipformer-korean-2024-06-16/joiner-epoch-99-avg-1.onnx"),_
paraformer=OnlineParaformerModelConfig(encoder="", decoder=""), wenet_
ctc=OnlineWenetCtcModelConfig(model="", chunk_size=16, num_left_chunks=4), zipformer2_
ctc=OnlineZipformer2CtcModelConfig(model=""), nemo_ctc=OnlineNeMoCtcModelConfig(model=""
), tokens="./sherpa-onnx-streaming-zipformer-korean-2024-06-16/tokens.txt", threads=1, warm_up=0, debug=False, provider="cpu", model_type="", modeling_unit=
"cjkchar", bpe_vocab=""), lm_config=OnlineLmConfig(model="", scale=0.5), endpoint_
324_Config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_trailing_
silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_nonsilence=True,_
min_trailing_silence=1.2, min_utterance_length=0), rule3=EndpointRule(must_contain_
nonsilence=False, min_trailing_silence=0, min_utterance_length=200), ctc_fst_decoder_
Chapter 8. sherpa-onnx
```

(continued from previous page)

```
./sherpa-onnx-streaming-zipformer-korean-2024-06-16/test_wavs/0.wav
Elapsed seconds: 0.56, Real time factor (RTF): 0.16

{ "text": " ", "tokens": [ " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " "],  

  "timestamps": [0.52, 0.96, 1.28, 1.44, 1.52, 1.84, 2.28, 2.48, 2.88, 3.04, 3.20, 3.44],  

  "ys_probs": [-1.701665, -0.208116, -0.527190, -1.777411, -1.853504, -0.768175, -1.  

  029222, -1.657714, -0.514807, -0.360788, -0.842238, -0.218511], "lm_probs": [],  

  "context_scores": [], "segment": 0, "words": [], "start_time": 0.00, "is_final": false}
```

## int8

The following code shows how to use int8 models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
  --tokens=./sherpa-onnx-streaming-zipformer-korean-2024-06-16/tokens.txt \
  --encoder=./sherpa-onnx-streaming-zipformer-korean-2024-06-16/encoder-epoch-99-avg-1.  

  int8.onnx \
  --decoder=./sherpa-onnx-streaming-zipformer-korean-2024-06-16/decoder-epoch-99-avg-1.  

  onnx \
  --joiner=./sherpa-onnx-streaming-zipformer-korean-2024-06-16/joiner-epoch-99-avg-1.  

  int8.onnx \
  ./sherpa-onnx-streaming-zipformer-korean-2024-06-16/test_wavs/0.wav
```

**Note:** Please use ./build/bin/Release/sherpa-onnx.exe for Windows.

**Caution:** If you use Windows and get encoding issues, please run:

CHCP 65001

in your commandline.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./  

  build/bin/sherpa-onnx --tokens=./sherpa-onnx-streaming-zipformer-korean-2024-06-16/  

  tokens.txt --encoder=./sherpa-onnx-streaming-zipformer-korean-2024-06-16/encoder-epoch-  

  99-avg-1.int8.onnx --decoder=./sherpa-onnx-streaming-zipformer-korean-2024-06-16/  

  decoder-epoch-99-avg-1.onnx --joiner=./sherpa-onnx-streaming-zipformer-korean-2024-06-  

  16/joiner-epoch-99-avg-1.int8.onnx ./sherpa-onnx-streaming-zipformer-korean-2024-06-16/  

  test_wavs/0.wav

OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_  

  dim=80, low_freq=20, high_freq=400, dither=0), model_=  

  config=OnlineModelConfig(transducer=OnlineTransducerModelConfig(encoder="./sherpa-onnx-  

  streaming-zipformer-korean-2024-06-16/encoder-epoch-99-avg-1.int8.onnx", decoder="./  

  sherpa-onnx-streaming-zipformer-korean-2024-06-16/decoder-epoch-99-avg-1.onnx", joiner_=  

  "./sherpa-onnx-streaming-zipformer-korean-2024-06-16/joiner-epoch-99-avg-1.int8.onnx"),  

  paraformer=OnlineParaformerModelConfig(encoder="", decoder=""), wenet_=  

  8.22. Pre-trained models
```

ModelConfig(model="", chunk\_size=16, num\_left\_chunks=4), zipformer\_=325  
 ctc=OnlineZipformer2CtcModelConfig(model=""), nemo\_ctc=OnlineNeMoCtcModelConfig(model=""),  
 tokens="./sherpa-onnx-streaming-zipformer-korean-2024-06-16/tokens.txt", num\_  
 threads=1, warm\_up=0, debug=False, provider="cpu", model\_type="", modeling\_unit=  
 "cikchar", bpe\_vocab=""), lm\_config=OnlineLmConfig(model="", scale=0.5), endpoint\_

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```
./sherpa-onnx-streaming-zipformer-korean-2024-06-16/test_wavs/0.wav
Elapsed seconds: 0.37, Real time factor (RTF): 0.1

{ "text": " ", "tokens": [ " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " " ],  
  "timestamps": [ 0.52, 0.96, 1.28, 1.44, 1.52, 1.84, 2.28, 2.48, 2.88, 3.04, 3.20, 3.44 ],  
  "ys_probs": [ -1.750286, -0.241571, -0.621155, -1.862032, -1.977561, -0.789718, -1.  
  002497, -1.627276, -0.554654, -0.443969, -0.852731, -0.218611 ], "lm_probs": [ ],  
  "context_scores": [ ], "segment": 0, "words": [ ], "start_time": 0.00, "is_final": false}
```

## Real-time speech recognition from a microphone

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-microphone \
  --tokens=./sherpa-onnx-streaming-zipformer-korean-2024-06-16/tokens.txt \
  --encoder=./sherpa-onnx-streaming-zipformer-korean-2024-06-16/encoder-epoch-99-avg-1.  
int8.onnx \
  --decoder=./sherpa-onnx-streaming-zipformer-korean-2024-06-16/decoder-epoch-99-avg-1.  
onnx \
  --joiner=./sherpa-onnx-streaming-zipformer-korean-2024-06-16/joiner-epoch-99-avg-1.  
int8.onnx
```

**Hint:** If your system is Linux (including embedded Linux), you can also use *sherpa-onnx-alsa* to do real-time speech recognition with your microphone if *sherpa-onnx-microphone* does not work for you.

## sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12-12 (Chinese)

Training code for this model can be found at <https://github.com/k2-fsa/icefall/pull/1369>. It supports only Chinese.

Please refer to [https://github.com/k2-fsa/icefall/tree/master/egs/multi\\_zh-hans/ASR#included-training-sets](https://github.com/k2-fsa/icefall/tree/master/egs/multi_zh-hans/ASR#included-training-sets) for the detailed information about the training data. In total, there are 14k hours of training data.

In the following, we describe how to download it and use it with *sherpa-onnx*.

### Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-  
streaming-zipformer-multi-zh-hans-2023-12-12.tar.bz2

# For Chinese users, you can use the following mirror
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-  
streaming-zipformer-multi-zh-hans-2023-12-12.tar.bz2
```

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```
tar xf sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12-12.tar.bz2
rm sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12-12.tar.bz2
ls -lh sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12-12
```

The output is given below:

```
$ ls -lh sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12-12
total 668864
-rw-r--r-- 1 fangjun staff 28B Dec 12 18:59 README.md
-rw-r--r-- 1 fangjun staff 131B Dec 12 18:59 bpe.model
-rw-r--r-- 1 fangjun staff 1.2M Dec 12 18:59 decoder-epoch-20-avg-1-chunk-16-left-
↪ 128.int8.onnx
-rw-r--r-- 1 fangjun staff 4.9M Dec 12 18:59 decoder-epoch-20-avg-1-chunk-16-left-
↪ 128.onnx
-rw-r--r-- 1 fangjun staff 67M Dec 12 18:59 encoder-epoch-20-avg-1-chunk-16-left-
↪ 128.int8.onnx
-rw-r--r-- 1 fangjun staff 249M Dec 12 18:59 encoder-epoch-20-avg-1-chunk-16-left-
↪ 128.onnx
-rw-r--r-- 1 fangjun staff 1.0M Dec 12 18:59 joiner-epoch-20-avg-1-chunk-16-left-128.
↪ int8.onnx
-rw-r--r-- 1 fangjun staff 3.9M Dec 12 18:59 joiner-epoch-20-avg-1-chunk-16-left-128.
↪ onnx
drwxr-xr-x 8 fangjun staff 256B Dec 12 18:59 test_wavs
-rw-r--r-- 1 fangjun staff 18K Dec 12 18:59 tokens.txt
```

## Decode a single wave file

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

## fp32

The following code shows how to use fp32 models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
--tokens=./sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12-12/tokens.txt \
--encoder=./sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12-12/encoder-epoch-20-
↪ avg-1-chunk-16-left-128.onnx \
--decoder=./sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12-12/decoder-epoch-20-
↪ avg-1-chunk-16-left-128.onnx \
--joiner=./sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12-12/joiner-epoch-20-
↪ avg-1-chunk-16-left-128.onnx \
./sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12-12/test_wavs/DEV_T000000000000.
↪ wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx.exe` for Windows.

**Caution:** If you use Windows and get encoding issues, please run:

```
CHCP 65001
```

in your commandline.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./  
build/bin/sherpa-onnx --tokens=./sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12-  
12/tokens.txt --encoder=./sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12-12/  
encoder-epoch-20-avg-1-chunk-16-left-128.onnx --decoder=./sherpa-onnx-streaming-  
zipformer-multi-zh-hans-2023-12-12/decoder-epoch-20-avg-1-chunk-16-left-128.onnx --  
joiner=./sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12-12/joiner-epoch-20-avg-  
1-chunk-16-left-128.onnx ./sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12-12/  
test_wavs/DEV_T0000000000.wav  
  
OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_  
dim=80), model_config=OnlineModelConfig(transducer=OnlineTransducerModelConfig(encoder=  
"./sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12-12/encoder-epoch-20-avg-1-  
chunk-16-left-128.onnx", decoder="./sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-  
12-12/decoder-epoch-20-avg-1-chunk-16-left-128.onnx", joiner="./sherpa-onnx-streaming-  
zipformer-multi-zh-hans-2023-12-12/joiner-epoch-20-avg-1-chunk-16-left-128.onnx"),  
paraformer=OnlineParaformerModelConfig(encoder="", decoder ""), wenet_  
ctc=OnlineWenetCtcModelConfig(model="", chunk_size=16, num_left_chunks=4), tokens="./  
sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12-12/tokens.txt", num_threads=1,  
debug=False, provider="cpu", model_type=""), lm_config=OnlineLMConfig(model="",  
scale=0.5), endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_  
nonsilence=False, min_trailing_silence=2.4, min_utterance_length=0),  
rule2=EndpointRule(must_contain_nonsilence=True, min_trailing_silence=1.2, min_  
utterance_length=0), rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_  
silence=0, min_utterance_length=20)), enable_endpoint=True, max_active_paths=4,  
hotwords_score=1.5, hotwords_file="", decoding_method="greedy_search")  
./sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12-12/test_wavs/DEV_T0000000000.wav  
Elapsed seconds: 0.65, Real time factor (RTF): 0.12  
  
{"is_final":false, "segment":0, "start_time":0.00, "text": " ", "timestamps": [0.32, 0.  
64, 0.76, 0.84, 1.08, 1.24, 1.96, 2.04, 2.24, 2.36, 2.56, 2.68, 2.80, 3.28, 3.40, 3.60,  
3.72, 3.84, 3.96, 4.04, 4.16, 4.28, 4.36, 4.60, 4.72], "tokens":[" ", "", "", "", "",  
"", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "",  
""]}
```

## int8

The following code shows how to use int8 models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
--tokens=./sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12-12/tokens.txt \
--encoder=./sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12-12/encoder-epoch-20- \
avg-1-chunk-16-left-128.int8.onnx \
--decoder=./sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12-12/decoder-epoch-20- \
avg-1-chunk-16-left-128.onnx \
--joiner=./sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12-12/joiner-epoch-20- \
avg-1-chunk-16-left-128.int8.onnx \
./sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12-12/test_wavs/DEV_T000000000000. \
.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx.exe` for Windows.

**Caution:** If you use Windows and get encoding issues, please run:

```
CHCP 65001
```

in your commandline.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./ \
build/bin/sherpa-onnx --tokens=./sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12- \
12/tokens.txt --encoder=./sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12-12/ \
encoder-epoch-20-avg-1-chunk-16-left-128.int8.onnx --decoder=./sherpa-onnx-streaming- \
zipformer-multi-zh-hans-2023-12-12/decoder-epoch-20-avg-1-chunk-16-left-128.onnx -- \
joiner=./sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12-12/joiner-epoch-20-avg- \
1-chunk-16-left-128.int8.onnx ./sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12- \
12/test_wavs/DEV_T000000000000.wav

OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_ \
dim=80), model_config=OnlineModelConfig(transducer=OnlineTransducerModelConfig(encoder= \
"./sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12-12/encoder-epoch-20-avg-1- \
chunk-16-left-128.int8.onnx", decoder="./sherpa-onnx-streaming-zipformer-multi-zh-hans- \
2023-12-12/decoder-epoch-20-avg-1-chunk-16-left-128.onnx", joiner="./sherpa-onnx- \
streaming-zipformer-multi-zh-hans-2023-12-12/joiner-epoch-20-avg-1-chunk-16-left-128. \
int8.onnx"), paraformer=OnlineParaformerModelConfig(encoder="", decoder=""), wenet_ \
ctc=OnlineWenetCtcModelConfig(model="", chunk_size=16, num_left_chunks=4), tokens="./ \
sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12-12/tokens.txt", num_threads=1, \
debug=False, provider="cpu", model_type=""), lm_config=OnlineLMConfig(model="", \
scale=0.5), endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_ \
nonsilence=False, min_trailing_silence=2.4, min_utterance_length=0), \
rule2=EndpointRule(must_contain_nonsilence=True, min_trailing_silence=1.2, min_ \
utterance_length=0), rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_ \
silence=0, min_utterance_length=20)), enable_endpoint=True, max_active_paths=4, \
hotwords_score=1.5, hotwords_file="", decoding_method="greedy_search") (continues on next page)
```

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```
./sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12-12/test_wavs/DEV_T0000000000.wav
Elapsed seconds: 0.5, Real time factor (RTF): 0.088

{"is_final":false, "segment":0, "start_time":0.00, "text": " ", "timestamps": [0.32, 0.
˓→64, 0.76, 0.84, 1.04, 1.24, 1.96, 2.04, 2.24, 2.36, 2.56, 2.68, 2.88, 3.28, 3.40, 3.60,
˓→3.72, 3.84, 3.96, 4.04, 4.16, 4.28, 4.36, 4.60, 4.72], "tokens":[" ", "", "", "", "", "",
˓→"", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", ""],}
```

## Real-time speech recognition from a microphone

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-microphone \
--tokens=./sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12-12/tokens.txt \
--encoder=./sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12-12/encoder-epoch-20-
˓→avg-1-chunk-16-left-128.int8.onnx \
--decoder=./sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12-12/decoder-epoch-20-
˓→avg-1-chunk-16-left-128.onnx \
--joiner=./sherpa-onnx-streaming-zipformer-multi-zh-hans-2023-12-12/joiner-epoch-20-
˓→avg-1-chunk-16-left-128.int8.onnx
```

**Hint:** If your system is Linux (including embedded Linux), you can also use *sherpa-onnx-alsa* to do real-time speech recognition with your microphone if *sherpa-onnx-microphone* does not work for you.

## pkufool/icefall-asr-zipformer-streaming-wenetspeech-20230615 (Chinese)

This model is from

<https://huggingface.co/pkufool/icefall-asr-zipformer-streaming-wenetspeech-20230615>

which supports only Chinese as it is trained on the [WenetSpeech](#) corpus.

If you are interested in how the model is trained, please refer to <https://github.com/k2-fsa/icefall/pull/1130>.

In the following, we describe how to download it and use it with *sherpa-onnx*.

### Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/icefall-asr-
˓→zipformer-streaming-wenetspeech-20230615.tar.bz2

# For Chinese users, you can use the following mirror
# wget https://hub.nuua.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/icefall-asr-
˓→zipformer-streaming-wenetspeech-20230615.tar.bz2
```

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```
tar xvf icefall-asr-zipformer-streaming-wenetspeech-20230615.tar.bz2
rm icefall-asr-zipformer-streaming-wenetspeech-20230615.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of \*.onnx files below.

```
icefall-asr-zipformer-streaming-wenetspeech-20230615 fangjun$ ls -lh exp/*chunk-16-left-
→ 128.*onnx
-rw-r--r-- 1 fangjun staff 11M Jun 26 15:42 exp/decoder-epoch-12-avg-4-chunk-16-
→ left-128.int8.onnx
-rw-r--r-- 1 fangjun staff 12M Jun 26 15:42 exp/decoder-epoch-12-avg-4-chunk-16-
→ left-128.onnx
-rw-r--r-- 1 fangjun staff 68M Jun 26 15:42 exp/encoder-epoch-12-avg-4-chunk-16-
→ left-128.int8.onnx
-rw-r--r-- 1 fangjun staff 250M Jun 26 15:43 exp/encoder-epoch-12-avg-4-chunk-16-
→ left-128.onnx
-rw-r--r-- 1 fangjun staff 2.7M Jun 26 15:42 exp/joiner-epoch-12-avg-4-chunk-16-left-
→ 128.int8.onnx
-rw-r--r-- 1 fangjun staff 11M Jun 26 15:42 exp/joiner-epoch-12-avg-4-chunk-16-left-
→ 128.onnx
```

## Decode a single wave file

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

### fp32

The following code shows how to use fp32 models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
--tokens=./icefall-asr-zipformer-streaming-wenetspeech-20230615/data/lang_char/tokens.
→ txt \
--encoder=./icefall-asr-zipformer-streaming-wenetspeech-20230615/exp/encoder-epoch-12-
→ avg-4-chunk-16-left-128.onnx \
--decoder=./icefall-asr-zipformer-streaming-wenetspeech-20230615/exp/decoder-epoch-12-
→ avg-4-chunk-16-left-128.onnx \
--joiner=./icefall-asr-zipformer-streaming-wenetspeech-20230615/exp/joiner-epoch-12-
→ avg-4-chunk-16-left-128.onnx \
./icefall-asr-zipformer-streaming-wenetspeech-20230615/test_wavs/DEV_T0000000000.wav
```

**Note:** Please use ./build/bin/Release/sherpa-onnx.exe for Windows.

**Caution:** If you use Windows and get encoding issues, please run:

CHCP 65001

in your commandline.

You should see the following output:

int8

The following code shows how to use `int8` models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
--tokens=./icefall-asr-zipformer-streaming-wenetspeech-20230615/data/lang_char/tokens.
↪txt \
--encoder=./icefall-asr-zipformer-streaming-wenetspeech-20230615/exp/encoder-epoch-12-
↪avg-4-chunk-16-left-128.int8.onnx \
--decoder=./icefall-asr-zipformer-streaming-wenetspeech-20230615/exp/decoder-epoch-12-
↪avg-4-chunk-16-left-128.onnx \
(continues on next page)
```

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```
--joiner=./icefall-asr-zipformer-streaming-wenetspeech-20230615/exp/joiner-epoch-12-  
→avg-4-chunk-16-left-128.int8.onnx \  
./icefall-asr-zipformer-streaming-wenetspeech-20230615/test_wavs/DEV_T0000000000.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx.exe` for Windows.

**Caution:** If you use Windows and get encoding issues, please run:

CHCP 65001

in your commandline.

You should see the following output:

## Real-time speech recognition from a microphone

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-microphone \
--tokens=./icefall-asr-zipformer-streaming-wenetspeech-20230615/data/lang_char/tokens.
↪txt \
--encoder=./icefall-asr-zipformer-streaming-wenetspeech-20230615/exp/encoder-epoch-12-
↪avg-4-chunk-16-left-128.int8.onnx \
--decoder=./icefall-asr-zipformer-streaming-wenetspeech-20230615/exp/decoder-epoch-12-
↪avg-4-chunk-16-left-128.onnx \
--joiner=./icefall-asr-zipformer-streaming-wenetspeech-20230615/exp/joiner-epoch-12-
↪avg-4-chunk-16-left-128.int8.onnx
```

---

**Hint:** If your system is Linux (including embedded Linux), you can also use *sherpa-onnx-alsa* to do real-time speech recognition with your microphone if *sherpa-onnx-microphone* does not work for you.

---

## csukuangfj/sherpa-onnx-streaming-zipformer-en-2023-06-26 (English)

This model is converted from

<https://huggingface.co/Zengwei/icefall-asr-librispeech-streaming-zipformer-2023-05-17>

which supports only English as it is trained on the *LibriSpeech* corpus.

If you are interested in how the model is trained, please refer to <https://github.com/k2-fsa/icefall/pull/1058>.

In the following, we describe how to download it and use it with *sherpa-onnx*.

### Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
↪streaming-zipformer-en-2023-06-26.tar.bz2

# For Chinese users, you can use the following mirror
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
↪streaming-zipformer-en-2023-06-26.tar.bz2

tar xvf sherpa-onnx-streaming-zipformer-en-2023-06-26.tar.bz2
rm sherpa-onnx-streaming-zipformer-en-2023-06-26.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes below.

```
-rw-r--r-- 1 1001 127 240K Apr 23 06:45 bpe.model
-rw-r--r-- 1 1001 127 1.3M Apr 23 06:45 decoder-epoch-99-avg-1-chunk-16-left-128.int8.
↪onnx
-rw-r--r-- 1 1001 127 2.0M Apr 23 06:45 decoder-epoch-99-avg-1-chunk-16-left-128.onnx
```

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```
-rw-r--r-- 1 1001 127 68M Apr 23 06:45 encoder-epoch-99-avg-1-chunk-16-left-128.int8.
→ onnx
-rw-r--r-- 1 1001 127 250M Apr 23 06:45 encoder-epoch-99-avg-1-chunk-16-left-128.onnx
-rwxr-xr-x 1 1001 127 814 Apr 23 06:45 export-onnx-zipformer-online.sh
-rw-r--r-- 1 1001 127 254K Apr 23 06:45 joiner-epoch-99-avg-1-chunk-16-left-128.int8.
→ onnx
-rw-r--r-- 1 1001 127 1003K Apr 23 06:45 joiner-epoch-99-avg-1-chunk-16-left-128.onnx
-rw-r--r-- 1 1001 127 216 Apr 23 06:45 README.md
drwxr-xr-x 2 1001 127 4.0K Apr 23 06:45 test_wavs
-rw-r--r-- 1 1001 127 5.0K Apr 23 06:45 tokens.txt
```

## Decode a single wave file

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

## fp32

The following code shows how to use fp32 models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
--tokens=./sherpa-onnx-streaming-zipformer-en-2023-06-26/tokens.txt \
--encoder=./sherpa-onnx-streaming-zipformer-en-2023-06-26/encoder-epoch-99-avg-1-chunk-
→ 16-left-128.onnx \
--decoder=./sherpa-onnx-streaming-zipformer-en-2023-06-26/decoder-epoch-99-avg-1-chunk-
→ 16-left-128.onnx \
--joiner=./sherpa-onnx-streaming-zipformer-en-2023-06-26/joiner-epoch-99-avg-1-chunk-
→ 16-left-128.onnx \
./sherpa-onnx-streaming-zipformer-en-2023-06-26/test_wavs/0.wav
```

**Note:** Please use ./build/bin/Release/sherpa-onnx.exe for Windows.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./
→ build/bin/sherpa-onnx --tokens=./sherpa-onnx-streaming-zipformer-en-2023-06-26/tokens.
→ txt --encoder=./sherpa-onnx-streaming-zipformer-en-2023-06-26/encoder-epoch-99-avg-1-
→ chunk-16-left-128.onnx --decoder=./sherpa-onnx-streaming-zipformer-en-2023-06-26/
→ decoder-epoch-99-avg-1-chunk-16-left-128.onnx --joiner=./sherpa-onnx-streaming-
→ zipformer-en-2023-06-26/joiner-epoch-99-avg-1-chunk-16-left-128.onnx ./sherpa-onnx-
→ streaming-zipformer-en-2023-06-26/test_wavs/0.wav

OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_
→ dim=80, model_config=OnlineTransducerModelConfig(encoder_filename="./sherpa-onnx-
→ streaming-zipformer-en-2023-06-26/encoder-epoch-99-avg-1-chunk-16-left-128.onnx", u
→ decoder_filename="./sherpa-onnx-streaming-zipformer-en-2023-06-26/decoder-epoch-99-avg-  

→ 1-chunk-16-left-128.onnx", joiner_filename="./sherpa-onnx-streaming-zipformer-en-2023-  

→ 06-26/joiner-epoch-99-avg-1-chunk-16-left-128.onnx", tokens="./sherpa-onnx-streaming  

→ zipformer-en-2023-06-26/tokens.txt", num_threads=2, provider="cpu", debug=False), lm_
→ config=OnlineLMConfig(model="", scale=0.5), endpoint_
→ config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_trailing_
→ silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_nonsilence=True  

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```

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```
./sherpa-onnx-streaming-zipformer-en-2023-06-26/test_wavs/0.wav
Elapsed seconds: 0.51, Real time factor (RTF): 0.077
AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID QUARTER OF THE BROTHELS
{"is_final":false,"segment":0,"start_time":0.0,"text":" AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID QUARTER OF THE BROTHELS","timestamps": "[0.68, 1.04, 1.16, 1.24, 1.60, 1.76, 1.80, 1.92, 2.04, 2.24, 2.32, 2.36, 2.52, 2.68, 2.72, 2.80, 2.92, 3.12, 3.40, 3.64, 3.76, 3.92, 4.12, 4.48, 4.68, 4.72, 4.84, 5.00, 5.20, 5.24, 5.36, 5.40, 5.64, 5.76, 5.92, 5.96, 6.08, 6.24, 6.52]", "tokens": [" AFTER", " E", "AR", "LY", " NIGHT", "F", "A", "LL", " THE", " YE", "LL", "OW", " LA", "M", "P", "S", " WOULD", "U", "LIGHT", " UP", " HE", "RE", " AND", " THERE", " THE", " S", "QUA", "LI", "D", " ", "QUA", "R", "TER", " OF", " THE", " B", "RO", "TH", "EL", "S"]}
```

**int8**

The following code shows how to use int8 models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
--tokens=./sherpa-onnx-streaming-zipformer-en-2023-06-26/tokens.txt \
--encoder=./sherpa-onnx-streaming-zipformer-en-2023-06-26/encoder-epoch-99-avg-1-chunk-16-left-128.int8.onnx \
--decoder=./sherpa-onnx-streaming-zipformer-en-2023-06-26/decoder-epoch-99-avg-1-chunk-16-left-128.onnx \
--joiner=./sherpa-onnx-streaming-zipformer-en-2023-06-26/joiner-epoch-99-avg-1-chunk-16-left-128.int8.onnx \
./sherpa-onnx-streaming-zipformer-en-2023-06-26/test_wavs/0.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx.exe` for Windows.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./
build/bin/sherpa-onnx --tokens=./sherpa-onnx-streaming-zipformer-en-2023-06-26/tokens.txt \
--encoder=./sherpa-onnx-streaming-zipformer-en-2023-06-26/encoder-epoch-99-avg-1-chunk-16-left-128.int8.onnx \
--decoder=./sherpa-onnx-streaming-zipformer-en-2023-06-26/decoder-epoch-99-avg-1-chunk-16-left-128.onnx \
--joiner=./sherpa-onnx-streaming-zipformer-en-2023-06-26/joiner-epoch-99-avg-1-chunk-16-left-128.int8.onnx \
./sherpa-onnx-streaming-zipformer-en-2023-06-26/test_wavs/0.wav

OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_dim=80), model_config=OnlineTransducerModelConfig(encoder_filename="./sherpa-onnx-streaming-zipformer-en-2023-06-26/encoder-epoch-99-avg-1-chunk-16-left-128.int8.onnx", decoder_filename="./sherpa-onnx-streaming-zipformer-en-2023-06-26/decoder-epoch-99-avg-1-chunk-16-left-128.onnx", joiner_filename="./sherpa-onnx-streaming-zipformer-en-2023-06-26/joiner-epoch-99-avg-1-chunk-16-left-128.int8.onnx", tokens="./sherpa-onnx-streaming-zipformer-en-2023-06-26/tokens.txt", num_threads=2, provider="cpu", debug=False), lm_config=OnlineLMConfig(model="", scale=0.5), endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_trailing_silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_nonsilence=True, min_trailing_silence=1.2, min_utterance_length=0), rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_silence=0, min_utterance_length=200)), enable_endpoint=True, max_active_paths=4, decoding_method="greedy_search")
```

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```
./sherpa-onnx-streaming-zipformer-en-2023-06-26/test_wavs/0.wav
Elapsed seconds: 0.41, Real time factor (RTF): 0.062
AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID QUARTER OF THE BROTHELS
{"is_final":false,"segment":0,"start_time":0.0,"text":" AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID QUARTER OF THE BROTHELS","timestamps": "[0.68, 1.04, 1.16, 1.24, 1.60, 1.76, 1.80, 1.92, 2.04, 2.24, 2.32, 2.36, 2.52, 2.68, 2.72, 2.80, 2.92, 3.12, 3.40, 3.64, 3.76, 3.92, 4.12, 4.48, 4.68, 4.72, 4.84, 5.00, 5.20, 5.24, 5.36, 5.44, 5.64, 5.76, 5.92, 5.96, 6.08, 6.24, 6.52]", "tokens": [" AFTER", " E", "AR", "LY", " NIGHT", "F", "A", "LL", " THE", " YE", "LL", "OW", " LA", "M", "P", "S", " WOULD", " LIGHT", " UP", " HE", "RE", " AND", " THERE", " THE", " S", "QUA", "LI", "D", " ", "QUA", "R", "TER", " OF", " THE", " B", "RO", "TH", "EL", "S"]}
```

## Real-time speech recognition from a microphone

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-microphone \
--tokens=./sherpa-onnx-streaming-zipformer-en-2023-06-26/tokens.txt \
--encoder=./sherpa-onnx-streaming-zipformer-en-2023-06-26/encoder-epoch-99-avg-1-chunk-16-left-128.onnx \
--decoder=./sherpa-onnx-streaming-zipformer-en-2023-06-26/decoder-epoch-99-avg-1-chunk-16-left-128.onnx \
--joiner=./sherpa-onnx-streaming-zipformer-en-2023-06-26/joiner-epoch-99-avg-1-chunk-16-left-128.onnx
```

**Hint:** If your system is Linux (including embedded Linux), you can also use *sherpa-onnx-alsa* to do real-time speech recognition with your microphone if *sherpa-onnx-microphone* does not work for you.

## cskuangji/sherpa-onnx-streaming-zipformer-en-2023-06-21 (English)

This model is converted from

<https://huggingface.co/marcoyang/icefall-libri-giga-pruned-transducer-stateless7-streaming-2023-04-04>

which supports only English as it is trained on the LibriSpeech and GigaSpeech corpus.

If you are interested in how the model is trained, please refer to <https://github.com/k2-fsa/icefall/pull/984>.

In the following, we describe how to download it and use it with *sherpa-onnx*.

## Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
˓→streaming-zipformer-en-2023-06-21.tar.bz2

# For Chinese users, you can use the following mirror
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
˓→streaming-zipformer-en-2023-06-21.tar.bz2

tar xvf sherpa-onnx-streaming-zipformer-en-2023-06-21.tar.bz2
rm sherpa-onnx-streaming-zipformer-en-2023-06-21.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of \*.onnx files below.

```
sherpa-onnx-streaming-zipformer-en-2023-06-21 fangjun$ ls -lh *.onnx
-rw-r--r-- 1 fangjun staff 1.2M Jun 21 15:34 decoder-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 fangjun staff 2.0M Jun 21 15:34 decoder-epoch-99-avg-1.onnx
-rw-r--r-- 1 fangjun staff 179M Jun 21 15:36 encoder-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 fangjun staff 337M Jun 21 15:37 encoder-epoch-99-avg-1.onnx
-rw-r--r-- 1 fangjun staff 253K Jun 21 15:34 joiner-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 fangjun staff 1.0M Jun 21 15:34 joiner-epoch-99-avg-1.onnx
```

## Decode a single wave file

---

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

---

### fp32

The following code shows how to use fp32 models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
--tokens=./sherpa-onnx-streaming-zipformer-en-2023-06-21/tokens.txt \
--encoder=./sherpa-onnx-streaming-zipformer-en-2023-06-21/encoder-epoch-99-avg-1.onnx \
--decoder=./sherpa-onnx-streaming-zipformer-en-2023-06-21/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-streaming-zipformer-en-2023-06-21/joiner-epoch-99-avg-1.onnx \
./sherpa-onnx-streaming-zipformer-en-2023-06-21/test_wavs/0.wav
```

---

**Note:** Please use ./build/bin/Release/sherpa-onnx.exe for Windows.

---

You should see the following output:

```

/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./
build/bin/sherpa-onnx --tokens=./sherpa-onnx-streaming-zipformer-en-2023-06-21/tokens.
--encoder=./sherpa-onnx-streaming-zipformer-en-2023-06-21/encoder-epoch-99-avg-1.
--onnx --decoder=./sherpa-onnx-streaming-zipformer-en-2023-06-21/decoder-epoch-99-avg-1.
--onnx --joiner=./sherpa-onnx-streaming-zipformer-en-2023-06-21/joiner-epoch-99-avg-1.
--onnx ./sherpa-onnx-streaming-zipformer-en-2023-06-21/test_wavs/0.wav

OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_
dim=80), model_config=OnlineTransducerModelConfig(encoder_filename="./sherpa-onnx-
streaming-zipformer-en-2023-06-21/encoder-epoch-99-avg-1.onnx", decoder_filename="./
sherpa-onnx-streaming-zipformer-en-2023-06-21/decoder-epoch-99-avg-1.onnx", joiner_
filename="./sherpa-onnx-streaming-zipformer-en-2023-06-21/joiner-epoch-99-avg-1.onnx",_
tokens="./sherpa-onnx-streaming-zipformer-en-2023-06-21/tokens.txt", num_threads=2,_
provider="cpu", debug=False), lm_config=OnlineLMConfig(model="", scale=0.5), endpoint_
config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_trailing_
silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_nonsilence=True,_
min_trailing_silence=1.2, min_utterance_length=0), rule3=EndpointRule(must_contain_
nonsilence=False, min_trailing_silence=0, min_utterance_length=20)), enable_
endpoint=True, max_active_paths=4, decoding_method="greedy_search")
./sherpa-onnx-streaming-zipformer-en-2023-06-21/test_wavs/0.wav
Elapsed seconds: 0.5, Real time factor (RTF): 0.076
AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID_
QUARTER OF THE BROTHELS
{"is_final":false,"segment":0,"start_time":0.0,"text":" AFTER EARLY NIGHTFALL THE YELLOW_
LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID QUARTER OF THE BROTHELS","timestamps":_
"[0.64, 1.00, 1.12, 1.20, 1.60, 1.76, 1.84, 1.96, 2.08, 2.24, 2.36, 2.40, 2.60, 2.72,_
2.80, 2.88, 3.00, 3.20, 3.44, 3.68, 3.76, 3.96, 4.24, 4.52, 4.72, 4.76, 4.88, 5.04, 5.24, 5.28, 5.36, 5.48, 5.64, 5.76, 5.92, 5.96, 6.04, 6.24, 6.36]", "tokens": [" AFTER", " E",_
", "AR", "LY", " NIGHT", "F", "A", "LL", " THE", " YE", "LL", "OW", " LA", "M", "P", "S", " WOULD", "U",_
"LIGHT", " UP", " HE", "RE", " AND", " THERE", " THE", " S", "QUA", "LI", "D", " ", "QUA", "R", "TER",_
" OF", " THE", " B", "RO", "TH", "EL", "S"]}
```

## int8

The following code shows how to use int8 models to decode a wave file:

```

cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
--tokens=./sherpa-onnx-streaming-zipformer-en-2023-06-21/tokens.txt \
--encoder=./sherpa-onnx-streaming-zipformer-en-2023-06-21/encoder-epoch-99-avg-1.int8.
--onnx \
--decoder=./sherpa-onnx-streaming-zipformer-en-2023-06-21/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-streaming-zipformer-en-2023-06-21/joiner-epoch-99-avg-1.int8.
--onnx \
./sherpa-onnx-streaming-zipformer-en-2023-06-21/test_wavs/0.wav
```

---

**Note:** Please use ./build/bin/Release/sherpa-onnx.exe for Windows.

---

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./  
build/bin/sherpa-onnx --tokens=./sherpa-onnx-streaming-zipformer-en-2023-06-21/tokens.  
txt --encoder=./sherpa-onnx-streaming-zipformer-en-2023-06-21/encoder-epoch-99-avg-1.  
int8.onnx --decoder=./sherpa-onnx-streaming-zipformer-en-2023-06-21/decoder-epoch-99-  
avg-1.onnx --joiner=./sherpa-onnx-streaming-zipformer-en-2023-06-21/joiner-epoch-99-  
avg-1.int8.onnx ./sherpa-onnx-streaming-zipformer-en-2023-06-21/test_wavs/0.wav  
  
OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_  
dim=80), model_config=OnlineTransducerModelConfig(encoder_filename="./sherpa-onnx-  
streaming-zipformer-en-2023-06-21/encoder-epoch-99-avg-1.int8.onnx", decoder_filename=  
"./sherpa-onnx-streaming-zipformer-en-2023-06-21/decoder-epoch-99-avg-1.onnx", joiner_  
filename="./sherpa-onnx-streaming-zipformer-en-2023-06-21/joiner-epoch-99-avg-1.int8.  
onnx", tokens="./sherpa-onnx-streaming-zipformer-en-2023-06-21/tokens.txt", num_  
threads=2, provider="cpu", debug=False), lm_config=OnlineLMConfig(model="", scale=0.5),  
endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_  
trailing_silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_  
nonsilence=True, min_trailing_silence=1.2, min_utterance_length=0),  
rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_silence=0, min_  
utterance_length=20)), enable_endpoint=True, max_active_paths=4, decoding_method=  
"greedy_search")  
./sherpa-onnx-streaming-zipformer-en-2023-06-21/test_wavs/0.wav  
Elapsed seconds: 0.41, Real time factor (RTF): 0.062  
AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID  
QUARTER OF THE BROTHELS  
{"is_final":false,"segment":0,"start_time":0.0,"text":" AFTER EARLY NIGHTFALL THE YELLOW  
LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID QUARTER OF THE BROTHELS","timestamps":  
"[0.64, 1.00, 1.12, 1.20, 1.60, 1.76, 1.80, 1.96, 2.08, 2.24, 2.36, 2.40, 2.60, 2.72,  
2.80, 2.88, 3.00, 3.20, 3.44, 3.68, 3.76, 3.96, 4.24, 4.52, 4.72, 4.76, 4.88, 5.04, 5.  
24, 5.28, 5.36, 5.48, 5.64, 5.76, 5.92, 5.96, 6.04, 6.24, 6.36]", "tokens": [" AFTER", " E  
", "AR", "LY", " NIGHT", "F", "A", "LL", " THE", " YE", "LL", "OW", " LA", "M", "P", "S", " WOULD", "  
LIGHT", " UP", " HE", "RE", " AND", " THERE", " THE", " S", "QUA", "LI", "D", " ", "QUA", "R", "TER",  
" OF", " THE", " B", "RO", "TH", "EL", "S"]}
```

### Real-time speech recognition from a microphone

```
cd /path/to/sherpa-onnx  
  
.build/bin/sherpa-onnx-microphone \  
--tokens=./sherpa-onnx-streaming-zipformer-en-2023-06-21/tokens.txt \  
--encoder=./sherpa-onnx-streaming-zipformer-en-2023-06-21/encoder-epoch-99-avg-1.onnx \  
--decoder=./sherpa-onnx-streaming-zipformer-en-2023-06-21/decoder-epoch-99-avg-1.onnx \  
--joiner=./sherpa-onnx-streaming-zipformer-en-2023-06-21/joiner-epoch-99-avg-1.onnx
```

---

**Hint:** If your system is Linux (including embedded Linux), you can also use *sherpa-onnx-alsa* to do real-time speech recognition with your microphone if *sherpa-onnx-microphone* does not work for you.

---

## csukuangfj/sherpa-onnx-streaming-zipformer-en-2023-02-21 (English)

This model is converted from

<https://huggingface.co/Zengwei/icefall-asr-librispeech-pruned-transducer-stateless7-streaming-2022-12-29>

which supports only English as it is trained on the [LibriSpeech](#) corpus.

You can find the training code at

[https://github.com/k2-fsa/icefall/tree/master/egs/librispeech/ASR/pruned\\_transducer\\_stateless7\\_streaming](https://github.com/k2-fsa/icefall/tree/master/egs/librispeech/ASR/pruned_transducer_stateless7_streaming)

In the following, we describe how to download it and use it with [sherpa-onnx](#).

### Download the model

Please use the following commands to download it.

GitHub

ModelScope

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
      -streaming-zipformer-en-2023-02-21.tar.bz2

# For Chinese users, you can use the following mirror
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
      -streaming-zipformer-en-2023-02-21.tar.bz2

tar xvf sherpa-onnx-streaming-zipformer-en-2023-02-21.tar.bz2
rm sherpa-onnx-streaming-zipformer-en-2023-02-21.tar.bz2
```

```
cd /path/to/sherpa-onnx

GIT_LFS_SKIP_SMUDGE=1 git clone https://www.modelscope.cn/pkufool/sherpa-onnx-streaming-
      -zipformer-en-2023-02-21.git
cd sherpa-onnx-streaming-zipformer-en-2023-02-21
git lfs pull --include "*.onnx"
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of \*.onnx files below.

```
sherpa-onnx-streaming-zipformer-en-2023-02-21$ ls -lh *.onnx
-rw-r--r-- 1 kuangfangjun root  1.3M Mar 31 23:06 decoder-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 kuangfangjun root  2.0M Feb 21 20:51 decoder-epoch-99-avg-1.onnx
-rw-r--r-- 1 kuangfangjun root 180M Mar 31 23:07 encoder-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 kuangfangjun root 338M Feb 21 20:51 encoder-epoch-99-avg-1.onnx
-rw-r--r-- 1 kuangfangjun root 254K Mar 31 23:06 joiner-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 kuangfangjun root 1003K Feb 21 20:51 joiner-epoch-99-avg-1.onnx
```

## Decode a single wave file

---

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

---

### fp32

The following code shows how to use fp32 models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
--tokens=./sherpa-onnx-streaming-zipformer-en-2023-02-21/tokens.txt \
--encoder=./sherpa-onnx-streaming-zipformer-en-2023-02-21/encoder-epoch-99-avg-1.onnx \
--decoder=./sherpa-onnx-streaming-zipformer-en-2023-02-21/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-streaming-zipformer-en-2023-02-21/joiner-epoch-99-avg-1.onnx \
./sherpa-onnx-streaming-zipformer-en-2023-02-21/test_wavs/0.wav
```

---

**Note:** Please use ./build/bin/Release/sherpa-onnx.exe for Windows.

---

You should see the following output:

```
OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_
˓dim=80), model_config=OnlineTransducerModelConfig(encoder_filename="./sherpa-onnx-
˓streaming-zipformer-en-2023-02-21/encoder-epoch-99-avg-1.onnx", decoder_filename="./
˓sherpa-onnx-streaming-zipformer-en-2023-02-21/decoder-epoch-99-avg-1.onnx", joiner_
˓filename="./sherpa-onnx-streaming-zipformer-en-2023-02-21/joiner-epoch-99-avg-1.onnx",_
˓tokens="./sherpa-onnx-streaming-zipformer-en-2023-02-21/tokens.txt", num_threads=2,_
˓debug=False), endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_
˓nonsilence=False, min_trailing_silence=2.4, min_utterance_length=0),_
˓rule2=EndpointRule(must_contain_nonsilence=True, min_trailing_silence=1.2, min_
˓utterance_length=0), rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_
˓silence=0, min_utterance_length=20)), enable_endpoint=True, max_active_paths=4,_
˓decoding_method="greedy_search")
2023-04-01 06:16:29.128344485 [E:onnxruntime:, env.cc:251 ThreadMain] pthread_
˓setaffinity_np failed for thread: 604840, index: 15, mask: {16, 52, }, error code: 22
˓error msg: Invalid argument. Specify the number of threads explicitly so the affinity_
˓is not set.
2023-04-01 06:16:29.128346568 [E:onnxruntime:, env.cc:251 ThreadMain] pthread_
˓setaffinity_np failed for thread: 604841, index: 16, mask: {17, 53, }, error code: 22
˓error msg: Invalid argument. Specify the number of threads explicitly so the affinity_
˓is not set.
sampling rate of input file: 16000
wav filename: ./sherpa-onnx-streaming-zipformer-en-2023-02-21/test_wavs/0.wav
wav duration (s): 6.625
Started
Done!
Recognition result for ./sherpa-onnx-streaming-zipformer-en-2023-02-21/test_wavs/0.wav:
AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID_
˓QUARTER OF THE BROTHELS
```

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```
num threads: 2
decoding method: greedy_search
Elapsed seconds: 0.825 s
Real time factor (RTF): 0.825 / 6.625 = 0.125
```

## int8

The following code shows how to use int8 models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
--tokens=./sherpa-onnx-streaming-zipformer-en-2023-02-21/tokens.txt \
--encoder=./sherpa-onnx-streaming-zipformer-en-2023-02-21/encoder-epoch-99-avg-1.int8.
˓→onnx \
--decoder=./sherpa-onnx-streaming-zipformer-en-2023-02-21/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-streaming-zipformer-en-2023-02-21/joiner-epoch-99-avg-1.int8.
˓→onnx \
./sherpa-onnx-streaming-zipformer-en-2023-02-21/test_wavs/0.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx.exe` for Windows.

You should see the following output:

```
OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_
˓→dim=80), model_config=OnlineTransducerModelConfig(encoder_filename="./sherpa-onnx-
˓→streaming-zipformer-en-2023-02-21/encoder-epoch-99-avg-1.int8.onnx", decoder_filename=
˓→"./sherpa-onnx-streaming-zipformer-en-2023-02-21/decoder-epoch-99-avg-1.onnx", joiner_
˓→filename="./sherpa-onnx-streaming-zipformer-en-2023-02-21/joiner-epoch-99-avg-1.int8.
˓→onnx", tokens="./sherpa-onnx-streaming-zipformer-en-2023-02-21/tokens.txt", num_
˓→threads=2, debug=False), endpoint_config=EndpointConfig(rule1=EndpointRule(must_
˓→contain_nonsilence=False, min_trailing_silence=2.4, min_utterance_length=0),_
˓→rule2=EndpointRule(must_contain_nonsilence=True, min_trailing_silence=1.2, min_
˓→utterance_length=0), rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_
˓→silence=0, min_utterance_length=20)), enable_endpoint=True, max_active_paths=4,_
˓→decoding_method="greedy_search")
2023-04-01 06:18:47.466564998 [E:onnxruntime:, env.cc:251 ThreadMain] pthread_
˓→setaffinity_np failed for thread: 604880, index: 15, mask: {16, 52, }, error code: 22
˓→error msg: Invalid argument. Specify the number of threads explicitly so the affinity
˓→is not set.
2023-04-01 06:18:47.466566863 [E:onnxruntime:, env.cc:251 ThreadMain] pthread_
˓→setaffinity_np failed for thread: 604881, index: 16, mask: {17, 53, }, error code: 22
˓→error msg: Invalid argument. Specify the number of threads explicitly so the affinity
˓→is not set.
sampling rate of input file: 16000
wav filename: ./sherpa-onnx-streaming-zipformer-en-2023-02-21/test_wavs/0.wav
wav duration (s): 6.625
Started
Done!
```

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```
Recognition result for ./sherpa-onnx-streaming-zipformer-en-2023-02-21/test_wavs/0.wav:
AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID
→ QUARTER OF THE BROTHELS
num threads: 2
decoding method: greedy_search
Elapsed seconds: 0.633 s
Real time factor (RTF): 0.633 / 6.625 = 0.096
```

## Real-time speech recognition from a microphone

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-microphone \
--tokens=./sherpa-onnx-streaming-zipformer-en-2023-02-21/tokens.txt \
--encoder=./sherpa-onnx-streaming-zipformer-en-2023-02-21/encoder-epoch-99-avg-1.onnx \
--decoder=./sherpa-onnx-streaming-zipformer-en-2023-02-21/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-streaming-zipformer-en-2023-02-21/joiner-epoch-99-avg-1.onnx
```

---

**Hint:** If your system is Linux (including embedded Linux), you can also use *sherpa-onnx-alsa* to do real-time speech recognition with your microphone if *sherpa-onnx-microphone* does not work for you.

---

## csukuangfj/sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20 (Bilingual, Chinese + English)

This model is converted from

<https://huggingface.co/csukuangfj/k2fsa-zipformer-chinese-english-mixed>

which supports both Chinese and English. The model is contributed by the community and is trained on tens of thousands of some internal dataset.

In the following, we describe how to download it and use it with *sherpa-onnx*.

### Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
→ streaming-zipformer-bilingual-zh-en-2023-02-20.tar.bz2

# For Chinese users, you can use the following mirror
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
→ streaming-zipformer-bilingual-zh-en-2023-02-20.tar.bz2

tar xvf sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20.tar.bz2
rm sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of \*.onnx files below.

```
sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20$ ls -lh *.onnx
-rw-r--r-- 1 kuangfangjun root 13M Mar 31 21:11 decoder-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 kuangfangjun root 14M Feb 20 20:13 decoder-epoch-99-avg-1.onnx
-rw-r--r-- 1 kuangfangjun root 174M Mar 31 21:11 encoder-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 kuangfangjun root 315M Feb 20 20:13 encoder-epoch-99-avg-1.onnx
-rw-r--r-- 1 kuangfangjun root 3.1M Mar 31 21:11 joiner-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 kuangfangjun root 13M Feb 20 20:13 joiner-epoch-99-avg-1.onnx
```

## Decode a single wave file

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

### fp32

The following code shows how to use fp32 models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
--tokens=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/tokens.txt \
--encoder=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/encoder-epoch-
99-avg-1.onnx \
--decoder=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/decoder-epoch-
99-avg-1.onnx \
--joiner=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/joiner-epoch-99-
avg-1.onnx \
./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/test_wavs/1.wav
```

**Note:** Please use ./build/bin/Release/sherpa-onnx.exe for Windows.

**Caution:** If you use Windows and get encoding issues, please run:

CHCP 65001

in your commandline.

You should see the following output:

```
OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_
dim=80), model_config=OnlineTransducerModelConfig(encoder_filename="./sherpa-onnx-
streaming-zipformer-en-2023-02-21/encoder-epoch-99-avg-1.onnx", decoder_filename="./
sherpa-onnx-streaming-zipformer-en-2023-02-21/decoder-epoch-99-avg-1.onnx", joiner_
filename="./sherpa-onnx-streaming-zipformer-en-2023-02-21/joiner-epoch-99-avg-1.onnx",_
tokens="./sherpa-onnx-streaming-zipformer-en-2023-02-21/tokens.txt", num_threads=2,_
debug=False), endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence_
continues on next page),_
nonsilence=False, min_trailing_silence=2.4, min_utterance_length=0),_
rule2=EndpointRule(must_contain_nonsilence=True, min_trailing_silence=1.2, min_
utterance_length=0), rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_
silence=0, min_utterance_length=20)), enable_endpoint=True, max_active_paths=4,_
decoding_method="greedy_search")
```

## 8.22. Pre-trained models

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```
2023-04-01 06:22:23.030317206 [E:onnxruntime:, env.cc:251 ThreadMain] pthread_
↳ setaffinity_np failed for thread: 604942, index: 16, mask: {17, 53, }, error code: 22
↳ error msg: Invalid argument. Specify the number of threads explicitly so the affinity
↳ is not set.
2023-04-01 06:22:23.030315351 [E:onnxruntime:, env.cc:251 ThreadMain] pthread_
↳ setaffinity_np failed for thread: 604941, index: 15, mask: {16, 52, }, error code: 22
↳ error msg: Invalid argument. Specify the number of threads explicitly so the affinity
↳ is not set.
sampling rate of input file: 16000
wav filename: ./sherpa-onnx-streaming-zipformer-en-2023-02-21/test_wavs/0.wav
wav duration (s): 6.625
Started
Done!
Recognition result for ./sherpa-onnx-streaming-zipformer-en-2023-02-21/test_wavs/0.wav:
AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID
↳ QUARTER OF THE BROTHELS
num threads: 2
decoding method: greedy_search
Elapsed seconds: 0.815 s
Real time factor (RTF): 0.815 / 6.625 = 0.123
```

## int8

The following code shows how to use fp32 models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
--tokens=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/tokens.txt \
--encoder=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/encoder-epoch-
↳ 99-avg-1.int8.onnx \
--decoder=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/decoder-epoch-
↳ 99-avg-1.int8.onnx \
--joiner=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/joiner-epoch-99-
↳ avg-1.int8.onnx \
./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/test_wavs/1.wav
```

**Note:** Please use ./build/bin/Release/sherpa-onnx.exe for Windows.

**Caution:** If you use Windows and get encoding issues, please run:

```
CHCP 65001
```

in your commandline.

You should see the following output:

```

OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_
˓dim=80), model_config=OnlineTransducerModelConfig(encoder_filename="./sherpa-onnx-
˓streaming-zipformer-bilingual-zh-en-2023-02-20/encoder-epoch-99-avg-1.int8.onnx",
˓decoder_filename="./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/decoder-
˓epoch-99-avg-1.int8.onnx", joiner_filename="./sherpa-onnx-streaming-zipformer-
˓bilingual-zh-en-2023-02-20/joiner-epoch-99-avg-1.int8.onnx", tokens="./sherpa-onnx-
˓streaming-zipformer-bilingual-zh-en-2023-02-20/tokens.txt", num_threads=2,_
˓debug=False), endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_
˓nonsense=False, min_trailing_silence=2.4, min_utterance_length=0),_
˓rule2=EndpointRule(must_contain_nonsense=True, min_trailing_silence=1.2, min_
˓utterance_length=0), rule3=EndpointRule(must_contain_nonsense=False, min_trailing_
˓silence=0, min_utterance_length=20)), enable_endpoint=True, max_active_paths=4,_
˓decoding_method="greedy_search")
2023-04-01 06:24:10.503505750 [E:onnxruntime:, env.cc:251 ThreadMain] pthread_
˓setaffinity_np failed for thread: 604982, index: 16, mask: {17, 53, }, error code: 22
˓error msg: Invalid argument. Specify the number of threads explicitly so the affinity_
˓is not set.
2023-04-01 06:24:10.503503942 [E:onnxruntime:, env.cc:251 ThreadMain] pthread_
˓setaffinity_np failed for thread: 604981, index: 15, mask: {16, 52, }, error code: 22
˓error msg: Invalid argument. Specify the number of threads explicitly so the affinity_
˓is not set.
sampling rate of input file: 16000
wav filename: ./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/test_wavs/1.
˓wav
wav duration (s): 5.100
Started
Done!
Recognition result for ./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/test_-
˓wavs/1.wav:
ALWAYS ALWAYS
num threads: 2
decoding method: greedy_search
Elapsed seconds: 0.551 s
Real time factor (RTF): 0.551 / 5.100 = 0.108

```

## Real-time speech recognition from a microphone

```

cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-microphone \
--tokens=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/tokens.txt \
--encoder=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/encoder-epoch-
˓99-avg-1.onnx \
--decoder=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/decoder-epoch-
˓99-avg-1.onnx \
--joiner=./sherpa-onnx-streaming-zipformer-bilingual-zh-en-2023-02-20/joiner-epoch-99-
˓avg-1.onnx

```

**Hint:** If your system is Linux (including embedded Linux), you can also use *sherpa-onnx-alsa* to do real-time speech recognition with your microphone if *sherpa-onnx-microphone* does not work for you.

## shaojieli/sherpa-onnx-streaming-zipformer-fr-2023-04-14 (French)

This model is converted from

<https://huggingface.co/shaojieli/icefall-asr-commonvoice-fr-pruned-transducer-stateless7-streaming-2023-04-02>

which supports only French as it is trained on the [CommonVoice](#) corpus. In the following, we describe how to download it and use it with [sherpa-onnx](#).

### Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
˓→streaming-zipformer-fr-2023-04-14.tar.bz2

# For Chinese users, you can use the following mirror
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
˓→streaming-zipformer-fr-2023-04-14.tar.bz2

tar xvf sherpa-onnx-streaming-zipformer-fr-2023-04-14.tar.bz2
rm sherpa-onnx-streaming-zipformer-fr-2023-04-14.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of \*.onnx files below.

```
sherpa-onnx-streaming-zipformer-fr-2023-04-14 shaojieli$ ls -lh *.bin

-rw-r--r-- 1 lishaojie Students  1.3M 4  14 14:09 decoder-epoch-29-avg-9-with-averaged-
˓→model.int8.onnx
-rw-r--r-- 1 lishaojie Students  2.0M 4  14 14:09 decoder-epoch-29-avg-9-with-averaged-
˓→model.onnx
-rw-r--r-- 1 lishaojie Students 121M 4  14 14:09 encoder-epoch-29-avg-9-with-averaged-
˓→model.int8.onnx
-rw-r--r-- 1 lishaojie Students 279M 4  14 14:09 encoder-epoch-29-avg-9-with-averaged-
˓→model.onnx
-rw-r--r-- 1 lishaojie Students 254K 4  14 14:09 joiner-epoch-29-avg-9-with-averaged-
˓→model.int8.onnx
-rw-r--r-- 1 lishaojie Students 1003K 4  14 14:09 joiner-epoch-29-avg-9-with-averaged-
˓→model.onnx
```

### Decode a single wave file

---

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

---

## fp32

The following code shows how to use fp32 models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
--tokens=./sherpa-onnx-streaming-zipformer-fr-2023-04-14/tokens.txt \
--encoder=./sherpa-onnx-streaming-zipformer-fr-2023-04-14/encoder-epoch-29-avg-9-with-
averaged-model.onnx \
--decoder=./sherpa-onnx-streaming-zipformer-fr-2023-04-14/decoder-epoch-29-avg-9-with-
averaged-model.onnx \
--joiner=./sherpa-onnx-streaming-zipformer-fr-2023-04-14/joiner-epoch-29-avg-9-with-
averaged-model.onnx \
./sherpa-onnx-streaming-zipformer-fr-2023-04-14/test_wavs/common_voice_fr_19364697.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx.exe` for Windows.

**Caution:** If you use Windows and get encoding issues, please run:

`CHCP 65001`

in your commandline.

You should see the following output:

```
OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_
dim=80), model_config=OnlineTransducerModelConfig(encoder_filename="./sherpa-onnx-
streaming-zipformer-fr-2023-04-14/encoder-epoch-29-avg-9-with-averaged-model.onnx",_
decoder_filename="./sherpa-onnx-streaming-zipformer-fr-2023-04-14/decoder-epoch-29-avg-
9-with-averaged-model.onnx", joiner_filename="./sherpa-onnx-streaming-zipformer-fr-
2023-04-14/joiner-epoch-29-avg-9-with-averaged-model.onnx", tokens="./sherpa-onnx-
streaming-zipformer-fr-2023-04-14/tokens.txt", num_threads=2, debug=False), endpoint_
config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_trailing_
silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_nonsilence=True,_
min_trailing_silence=1.2, min_utterance_length=0), rule3=EndpointRule(must_contain_
nonsilence=False, min_trailing_silence=0, min_utterance_length=20)), enable_
endpoint=True, max_active_paths=4, decoding_method="greedy_search")
sampling rate of input file: 16000
wav filename: ./sherpa-onnx-streaming-zipformer-fr-2023-04-14/test_wavs/common_voice_fr_-
19364697.wav
wav duration (s): 7.128
Started
Done!
Recognition result for ./sherpa-onnx-streaming-zipformer-fr-2023-04-14/test_wavs/common_-
voice_fr_19364697.wav:
CE SITE CONTIENT QUATRE TOMBEAUX DE LA DYNASTIE ASHÉMÉNIDE ET SEPT DES SASSANDIDES
num threads: 2
decoding method: greedy_search
Elapsed seconds: 0.458 s
Real time factor (RTF): 0.458 / 7.128 = 0.064
```

**int8**

The following code shows how to use fp32 models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
--tokens=./sherpa-onnx-streaming-zipformer-fr-2023-04-14/tokens.txt \
--encoder=./sherpa-onnx-streaming-zipformer-fr-2023-04-14/encoder-epoch-29-avg-9-with-
--averaged-model.int8.onnx \
--decoder=./sherpa-onnx-streaming-zipformer-fr-2023-04-14/decoder-epoch-29-avg-9-with-
--averaged-model.onnx \
--joiner=./sherpa-onnx-streaming-zipformer-fr-2023-04-14/joiner-epoch-29-avg-9-with-
--averaged-model.int8.onnx \
./sherpa-onnx-streaming-zipformer-fr-2023-04-14/test_wavs/common_voice_fr_19364697.wav
```

---

**Note:** Please use ./build/bin/Release/sherpa-onnx.exe for Windows.

---

**Caution:** If you use Windows and get encoding issues, please run:

```
CHCP 65001
```

in your commandline.

You should see the following output:

```
OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_
--dim=80), model_config=OnlineTransducerModelConfig(encoder_filename="./sherpa-onnx-
--streaming-zipformer-fr-2023-04-14/encoder-epoch-29-avg-9-with-averaged-model.int8.onnx
--", decoder_filename="./sherpa-onnx-streaming-zipformer-fr-2023-04-14/decoder-epoch-29-
--avg-9-with-averaged-model.onnx", joiner_filename="./sherpa-onnx-streaming-zipformer-fr-
--2023-04-14/joiner-epoch-29-avg-9-with-averaged-model.int8.onnx", tokens="./sherpa-onnx-
--streaming-zipformer-fr-2023-04-14/tokens.txt", num_threads=2, debug=False), endpoint_
--config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_trailing_
--silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_nonsilence=True,_
--min_trailing_silence=1.2, min_utterance_length=0), rule3=EndpointRule(must_contain_
--nonsilence=False, min_trailing_silence=0, min_utterance_length=20)), enable_
--endpoint=True, max_active_paths=4, decoding_method="greedy_search")
sampling rate of input file: 16000
wav filename: ./sherpa-onnx-streaming-zipformer-fr-2023-04-14/test_wavs/common_voice_fr-
--19364697.wav
wav duration (s): 7.128
Started
Done!
Recognition result for ./sherpa-onnx-streaming-zipformer-fr-2023-04-14/test_wavs/common_
--voice_fr_19364697.wav:
CE SITE CONTIENT QUATRE TOMBEAUX DE LA DYNASTIE ASHÉMÉNIDE ET SEPT DES SASSANDIDES
num threads: 2
decoding method: greedy_search
Elapsed seconds: 0.485 s
Real time factor (RTF): 0.485 / 7.128 = 0.068
```

## Real-time speech recognition from a microphone

```
cd /path/to/sherpa-onnx
./build/bin/sherpa-onnx-microphone \
--tokens=./sherpa-onnx-streaming-zipformer-fr-2023-04-14/tokens.txt \
--encoder=./sherpa-onnx-streaming-zipformer-fr-2023-04-14/encoder-epoch-29-avg-9-with-
→averaged-model.onnx \
--decoder=./sherpa-onnx-streaming-zipformer-fr-2023-04-14/decoder-epoch-29-avg-9-with-
→averaged-model.onnx \
--joiner=./sherpa-onnx-streaming-zipformer-fr-2023-04-14/joiner-epoch-29-avg-9-with-
→averaged-model.onnx
```

**Hint:** If your system is Linux (including embedded Linux), you can also use *sherpa-onnx-alsa* to do real-time speech recognition with your microphone if *sherpa-onnx-microphone* does not work for you.

## sherpa-onnx-streaming-zipformer-small-bilingual-zh-en-2023-02-16 (Bilingual, Chinese + English)

**Hint:** It is a small model.

This model is converted from

<https://huggingface.co/csukuangfj/k2fsa-zipformer-bilingual-zh-en-t>

which supports both Chinese and English. The model is contributed by the community and is trained on tens of thousands of some internal dataset.

In the following, we describe how to download it and use it with *sherpa-onnx*.

### Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
→streaming-zipformer-small-bilingual-zh-en-2023-02-16.tar.bz2

# For Chinese users, you can use the following mirror
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
→streaming-zipformer-small-bilingual-zh-en-2023-02-16.tar.bz2

tar xf sherpa-onnx-streaming-zipformer-small-bilingual-zh-en-2023-02-16.tar.bz2
rm sherpa-onnx-streaming-zipformer-small-bilingual-zh-en-2023-02-16.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of \*.onnx files below.

```
sherpa-onnx-streaming-zipformer-small-bilingual-zh-en-2023-02-16 fangjun$ ls -lh *.onnx
total 158M
drwxr-xr-x 2 1001 127 4.0K Mar 20 13:11 64
```

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```
drwxr-xr-x 2 1001 127 4.0K Mar 20 13:11 96
-rw-r--r-- 1 1001 127 240K Mar 20 13:11 bpe.model
-rw-r--r-- 1 1001 127 3.4M Mar 20 13:11 decoder-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 1001 127 14M Mar 20 13:11 decoder-epoch-99-avg-1.onnx
-rw-r--r-- 1 1001 127 41M Mar 20 13:11 encoder-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 1001 127 85M Mar 20 13:11 encoder-epoch-99-avg-1.onnx
-rw-r--r-- 1 1001 127 3.1M Mar 20 13:11 joiner-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 1001 127 13M Mar 20 13:11 joiner-epoch-99-avg-1.onnx
drwxr-xr-x 2 1001 127 4.0K Mar 20 13:11 test_wavs
-rw-r--r-- 1 1001 127 55K Mar 20 13:11 tokens.txt
```

**Hint:** There are two sub-folders in the model directory: 64 and 96. The number represents chunk size. The larger the number, the lower the RTF. The default chunk size is 32.

## Decode a single wave file

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

## fp32

The following code shows how to use fp32 models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
--tokens=./sherpa-onnx-streaming-zipformer-small-bilingual-zh-en-2023-02-16/tokens.txt \
--encoder=./sherpa-onnx-streaming-zipformer-small-bilingual-zh-en-2023-02-16/encoder-epoch-99-avg-1.onnx \
--decoder=./sherpa-onnx-streaming-zipformer-small-bilingual-zh-en-2023-02-16/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-streaming-zipformer-small-bilingual-zh-en-2023-02-16/joiner-epoch-99-avg-1.onnx \
./sherpa-onnx-streaming-zipformer-small-bilingual-zh-en-2023-02-16/test_wavs/0.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx.exe` for Windows.

**Caution:** If you use Windows and get encoding issues, please run:

`CHCP 65001`

in your commandline.

You should see the following output:

```
project/sherpa-onnx/csrc/parse-options.cc:Read:361 sherpa-onnx --tokens=./sherpa-onnx-  
→ streaming-zipformer-small-bilingual-zh-en-2023-02-16/tokens.txt --encoder=./sherpa-  
→ onnx-streaming-zipformer-small-bilingual-zh-en-2023-02-16/encoder-epoch-99-avg-1.onnx -  
→ -decoder=./sherpa-onnx-streaming-zipformer-small-bilingual-zh-en-2023-02-16/decoder-  
→ epoch-99-avg-1.onnx --joiner=./sherpa-onnx-streaming-zipformer-small-bilingual-zh-en-  
→ 2023-02-16/joiner-epoch-99-avg-1.onnx ./sherpa-onnx-streaming-zipformer-small-  
→ bilingual-zh-en-2023-02-16/test_wavs/0.wav  
  
OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_=  
→ dim=80), model_config=OnlineModelConfig(transducer=OnlineTransducerModelConfig(encoder=  
→ "./sherpa-onnx-streaming-zipformer-small-bilingual-zh-en-2023-02-16/encoder-epoch-99-  
→ avg-1.onnx", decoder="./sherpa-onnx-streaming-zipformer-small-bilingual-zh-en-2023-02-  
→ 16/decoder-epoch-99-avg-1.onnx", joiner="./sherpa-onnx-streaming-zipformer-small-  
→ bilingual-zh-en-2023-02-16/joiner-epoch-99-avg-1.onnx"),  
→ paraformer=OnlineParaformerModelConfig(encoder="", decoder=""), wenet_=  
→ ctc=OnlineWenetCtcModelConfig(model="", chunk_size=16, num_left_chunks=4), zipformer2_=  
→ ctc=OnlineZipformer2CtcModelConfig(model=""), tokens="./sherpa-onnx-streaming-  
→ zipformer-small-bilingual-zh-en-2023-02-16/tokens.txt", num_threads=1, debug=False,  
→ provider="cpu", model_type=""), lm_config=OnlineLMConfig(model="", scale=0.5),  
→ endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_=  
→ trailing_silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_=  
→ nonsilence=True, min_trailing_silence=1.2, min_utterance_length=0),  
→ rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_silence=0, min_=  
→ utterance_length=20)), enable_endpoint=True, max_active_paths=4, hotwords_score=1.5,  
→ hotwords_file="", decoding_method="greedy_search", blank_penalty=0)  
./sherpa-onnx-streaming-zipformer-small-bilingual-zh-en-2023-02-16/test_wavs/0.wav  
Elapsed seconds: 1, Real time factor (RTF): 0.1  
MONDAY TODAY IS THEY AFTER TOMORROW  
{ "text": " MONDAY TODAY IS THEY AFTER TOMORROW", "tokens": [ "", "", "", " MO", "N",  
→ "DAY", " TO", "DAY", " IS", " THEY", " AFTER", " TO", "M", "OR", "ROW", "", "", "", ""  
→ ], "timestamps": [ 0.64, 1.08, 1.64, 2.08, 2.20, 2.36, 4.16, 4.36, 5.12, 7.16, 7.44, 8.  
→ 00, 8.12, 8.20, 8.44, 9.08, 9.44, 9.64, 9.88 ], "ys_probs": [ -0.000507, -0.056152, -0.  
→ 007374, -0.213242, -0.362640, -0.117561, -1.036179, -0.219900, -0.150360, -0.734749,  
→ -0.113281, -0.060974, -0.117775, -0.361603, -0.039993, -0.217766, -0.042011, -0.108857,  
→ -0.135108 ], "lm_probs": [ ], "context_scores": [ ], "segment": 0, "start_time": 0.  
→ 00, "is_final": false}
```

int8

The following code shows how to use `int8` models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
--tokens=./sherpa-onnx-streaming-zipformer-small-bilingual-zh-en-2023-02-16/tokens.txt \
--encoder=./sherpa-onnx-streaming-zipformer-small-bilingual-zh-en-2023-02-16/encoder-epoch-99-avg-1.int8.onnx \
--decoder=./sherpa-onnx-streaming-zipformer-small-bilingual-zh-en-2023-02-16/decoder-epoch-99-avg-1.onnx \
```

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```
--joiner=./sherpa-onnx-streaming-zipformer-small-bilingual-zh-en-2023-02-16/joiner-  
epoch-99-avg-1.int8.onnx \  
./sherpa-onnx-streaming-zipformer-small-bilingual-zh-en-2023-02-16/test_wavs/0.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx.exe` for Windows.

**Caution:** If you use Windows and get encoding issues, please run:

CHCP 65001

in your commandline.

You should see the following output:

```
project/sherpa-onnx/csrc/parse-options.cc:Read:361 sherpa-onnx --tokens=./sherpa-onnx-  
streaming-zipformer-small-bilingual-zh-en-2023-02-16/tokens.txt --encoder=./sherpa-  
onnx-streaming-zipformer-small-bilingual-zh-en-2023-02-16/encoder-epoch-99-avg-1.int8.  
sherpa-onnx --decoder=./sherpa-onnx-streaming-zipformer-small-bilingual-zh-en-2023-02-16/  
decoder-epoch-99-avg-1.onnx --joiner=./sherpa-onnx-streaming-zipformer-small-bilingual-  
zh-en-2023-02-16/joiner-epoch-99-avg-1.int8.onnx ./sherpa-onnx-streaming-zipformer-  
small-bilingual-zh-en-2023-02-16/test_wavs/0.wav

OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_  
dim=80), model_config=OnlineModelConfig(transducer=OnlineTransducerModelConfig(encoder=  
"./sherpa-onnx-streaming-zipformer-small-bilingual-zh-en-2023-02-16/encoder-epoch-99-  
avg-1.int8.onnx", decoder="./sherpa-onnx-streaming-zipformer-small-bilingual-zh-en-  
2023-02-16/decoder-epoch-99-avg-1.onnx", joiner="./sherpa-onnx-streaming-zipformer-  
small-bilingual-zh-en-2023-02-16/joiner-epoch-99-avg-1.int8.onnx"),  
paraformer=OnlineParaformerModelConfig(encoder="", decoder=""), wenet_  
ctc=OnlineWenetCtcModelConfig(model="", chunk_size=16, num_left_chunks=4), zipformer2_  
ctc=OnlineZipformer2CtcModelConfig(model=""), tokens="./sherpa-onnx-streaming-  
zipformer-small-bilingual-zh-en-2023-02-16/tokens.txt", num_threads=1, debug=False,  
provider="cpu", model_type=""), lm_config=OnlineLMConfig(model="", scale=0.5),  
endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_  
trailing_silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_  
nonsilence=True, min_trailing_silence=1.2, min_utterance_length=0),  
rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_silence=0, min_  
utterance_length=20)), enable_endpoint=True, max_active_paths=4, hotwords_score=1.5,  
hotwords_file="", decoding_method="greedy_search", blank_penalty=0)  
./sherpa-onnx-streaming-zipformer-small-bilingual-zh-en-2023-02-16/test_wavs/0.wav  
Elapsed seconds: 0.69, Real time factor (RTF): 0.069  
MONDAY TODAY IS THEY AFTER TOMORROW  
{ "text": " MONDAY TODAY IS THEY AFTER TOMORROW", "tokens": [ "", "", "", " MO", "N",  
"DAY", " TO", "DAY", " IS", " THEY", " AFTER", " TO", "M", "OR", "ROW", "", "", "", "",  
"], "timestamps": [ 0.64, 1.08, 1.64, 2.08, 2.20, 2.36, 4.20, 4.36, 5.12, 7.16, 7.44, 8.  
00, 8.12, 8.20, 8.40, 9.04, 9.44, 9.64, 9.88 ], "ys_probs": [ -0.000305, -0.152557, -0.  
007835, -0.156221, -0.622139, -0.081843, -1.140152, -0.418322, -0.198410, -0.939461, -  
0.224989, -0.052963, -0.098366, -0.081665, -0.453255, -0.335670, -0.039482, -0.381765, -  
0.192475 ], "lm_probs": [ ], "context_scores": [ ], "segment": 0, "start_time": 0.  
00, "is_final": false}
```

## Real-time speech recognition from a microphone

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-microphone \
--tokens=./sherpa-onnx-streaming-zipformer-small-bilingual-zh-en-2023-02-16/tokens.txt \
--encoder=./sherpa-onnx-streaming-zipformer-small-bilingual-zh-en-2023-02-16/encoder-epoch-99-avg-1.int8.onnx \
--decoder=./sherpa-onnx-streaming-zipformer-small-bilingual-zh-en-2023-02-16/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-streaming-zipformer-small-bilingual-zh-en-2023-02-16/joiner-epoch-99-avg-1.int8.onnx
```

**Hint:** If your system is Linux (including embedded Linux), you can also use *sherpa-onnx-alsa* to do real-time speech recognition with your microphone if *sherpa-onnx-microphone* does not work for you.

## csukuangfj/sherpa-onnx-streaming-zipformer-zh-14M-2023-02-23 (Chinese)

**Hint:** It is a small model.

This model is from

<https://huggingface.co/marcoyang/sherpa-ncnn-streaming-zipformer-zh-14M-2023-02-23/>

which supports only Chinese as it is trained on the [WenetSpeech](#) corpus.

In the following, we describe how to download it and use it with *sherpa-onnx*.

### Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
streaming-zipformer-zh-14M-2023-02-23.tar.bz2

# For Chinese users, you can use the following mirror
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
# streaming-zipformer-zh-14M-2023-02-23.tar.bz2

tar xvf sherpa-onnx-streaming-zipformer-zh-14M-2023-02-23.tar.bz2
rm sherpa-onnx-streaming-zipformer-zh-14M-2023-02-23.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of \*.onnx files below.

```
sherpa-onnx-streaming-zipformer-zh-14M-2023-02-23 fangjun$ ls -lh *.onnx
-rw-r--r-- 1 fangjun staff 1.8M Sep 10 15:31 decoder-epoch-99-avg-1.int8.onnx
```

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-rw-r--r--	1	fangjun	staff	7.2M	Sep 10 15:31	decoder-epoch-99-avg-1.onnx
-rw-r--r--	1	fangjun	staff	21M	Sep 10 15:31	encoder-epoch-99-avg-1.int8.onnx
-rw-r--r--	1	fangjun	staff	39M	Sep 10 15:31	encoder-epoch-99-avg-1.onnx
-rw-r--r--	1	fangjun	staff	1.7M	Sep 10 15:31	joiner-epoch-99-avg-1.int8.onnx
-rw-r--r--	1	fangjun	staff	6.8M	Sep 10 15:31	joiner-epoch-99-avg-1.onnx

## Decode a single wave file

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

### fp32

The following code shows how to use fp32 models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
--tokens=./sherpa-onnx-streaming-zipformer-zh-14M-2023-02-23/tokens.txt \
--encoder=./sherpa-onnx-streaming-zipformer-zh-14M-2023-02-23/encoder-epoch-99-avg-1.
˓→onnx \
--decoder=./sherpa-onnx-streaming-zipformer-zh-14M-2023-02-23/decoder-epoch-99-avg-1.
˓→onnx \
--joiner=./sherpa-onnx-streaming-zipformer-zh-14M-2023-02-23/joiner-epoch-99-avg-1.
˓→onnx \
./sherpa-onnx-streaming-zipformer-zh-14M-2023-02-23/test_wavs/0.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx.exe` for Windows.

**Caution:** If you use Windows and get encoding issues, please run:

`CHCP 65001`

in your commandline.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./
˓→build/bin/sherpa-onnx --tokens=./sherpa-onnx-streaming-zipformer-zh-14M-2023-02-23/
˓→tokens.txt --encoder=./sherpa-onnx-streaming-zipformer-zh-14M-2023-02-23/encoder-epoch-
˓→99-avg-1.onnx --decoder=./sherpa-onnx-streaming-zipformer-zh-14M-2023-02-23/decoder-
˓→epoch-99-avg-1.onnx --joiner=./sherpa-onnx-streaming-zipformer-zh-14M-2023-02-23/
˓→joiner-epoch-99-avg-1.onnx ./sherpa-onnx-streaming-zipformer-zh-14M-2023-02-23/test_
˓→wavs/0.wav
```

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```
OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_dim=80), model_config=OnlineModelConfig(transducer=OnlineTransducerModelConfig(encoder=". ./sherpa-onnéx-streaming-zipformer-zh-14M-2023-02-23/encoder-epoch-99-avg-1.onnéx", decoder=". ./sherpa-onnéx-streaming-zipformer-zh-14M-2023-02-23/decoder-epoch-99-avg-1.onnéx", joiner=". ./sherpa-onnéx-streaming-zipformer-zh-14M-2023-02-23/joiner-epoch-99-avg-1.onnéx"), paraformer=OnlineParaformerModelConfig(encoder="", decoder ""), tokens=". ./sherpa-onnéx-streaming-zipformer-zh-14M-2023-02-23/tokens.txt", num_threads=1, debug=False, provider="cpu", model_type=""), lm_config=OnlineLMConfig(model="", scale=0.5), endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_trailing_silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_nonsilence=True, min_trailing_silence=1.2, min_utterance_length=0), rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_silence=0, min_utterance_length=20)), enable_endpoint=True, max_active_paths=4, context_score=1.5, decoding_method="greedy_search")  
. ./sherpa-onnéx-streaming-zipformer-zh-14M-2023-02-23/test_wavs/0.wav  
Elapsed seconds: 0.21, Real time factor (RTF): 0.038
```

int8

The following code shows how to use int8 models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnéx \
--tokens=./sherpa-onnéx-streaming-zipformer-zh-14M-2023-02-23/tokens.txt \
--encoder=./sherpa-onnéx-streaming-zipformer-zh-14M-2023-02-23/encoder-epoch-99-avg-1.
↪ int8.onnéx \
--decoder=./sherpa-onnéx-streaming-zipformer-zh-14M-2023-02-23/decoder-epoch-99-avg-1.
↪ onnx \
--joiner=./sherpa-onnéx-streaming-zipformer-zh-14M-2023-02-23/joiner-epoch-99-avg-1.
↪ int8.onnéx \
./sherpa-onnéx-streaming-zipformer-zh-14M-2023-02-23/test_wavs/0.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx.exe` for Windows.

**Caution:** If you use Windows and get encoding issues, please run:

CHCP 65001

in your commandline.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./  
build/bin/sherpa-onnx --tokens=./sherpa-onnx-streaming-zipformer-zh-14M-2023-02-23/  
tokens.txt --encoder=./sherpa-onnx-streaming-zipformer-zh-14M-2023-02-23/encoder-epoch-  
99-avg-1.int8.onnx --decoder=./sherpa-onnx-streaming-zipformer-zh-14M-2023-02-23/  
decoder-epoch-99-avg-1.onnx --joiner=./sherpa-onnx-streaming-zipformer-zh-14M-2023-02-  
23/joiner-epoch-99-avg-1.int8.onnx ./sherpa-onnx-streaming-zipformer-zh-14M-2023-02-23/  
test_wavs/0.wav  
  
OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_  
dim=80), model_config=OnlineModelConfig(transducer=OnlineTransducerModelConfig(encoder=  
"./sherpa-onnx-streaming-zipformer-zh-14M-2023-02-23/encoder-epoch-99-avg-1.int8.onnx",  
decoder="./sherpa-onnx-streaming-zipformer-zh-14M-2023-02-23/decoder-epoch-99-avg-1.  
onnx", joiner="./sherpa-onnx-streaming-zipformer-zh-14M-2023-02-23/joiner-epoch-99-avg-  
1.int8.onnx"), paraformer=OnlineParaformerModelConfig(encoder="", decoder ""), tokens=  
"./sherpa-onnx-streaming-zipformer-zh-14M-2023-02-23/tokens.txt", num_threads=1,  
debug=False, provider="cpu", model_type=""), lm_config=OnlineLMConfig(model="",  
scale=0.5), endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_  
nonsilence=False, min_trailing_silence=2.4, min_utterance_length=0),  
rule2=EndpointRule(must_contain_nonsilence=True, min_trailing_silence=1.2, min_  
utterance_length=0), rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_  
silence=0, min_utterance_length=20)), enable_endpoint=True, max_active_paths=4,  
context_score=1.5, decoding_method="greedy_search")  
./sherpa-onnx-streaming-zipformer-zh-14M-2023-02-23/test_wavs/0.wav  
Elapsed seconds: 0.16, Real time factor (RTF): 0.028  
  
{ "is_final":false, "segment":0, "start_time":0.0, "text": "", "timestamps": "[0.32, 0.64, 0.76,  
0.96, 1.08, 1.16, 1.92, 2.04, 2.24, 2.36, 2.56, 2.68, 2.76, 3.36, 3.52, 3.64, 3.72, 3.  
84, 3.92, 4.00, 4.08, 4.24, 4.48, 4.56, 4.72]", "tokens": [ "", "", "", "", "", "", "", "", "",  
" ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ",  
" ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ",  
" ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ",  
" ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ", " ] } }
```

## Real-time speech recognition from a microphone

```
cd /path/to/sherpa-onnx  
  
./build/bin/sherpa-onnx-microphone \  
--tokens=./sherpa-onnx-streaming-zipformer-zh-14M-2023-02-23/tokens.txt \  
--encoder=./sherpa-onnx-streaming-zipformer-zh-14M-2023-02-23/encoder-epoch-99-avg-1.  
onnx \  
--decoder=./sherpa-onnx-streaming-zipformer-zh-14M-2023-02-23/decoder-epoch-99-avg-1.  
onnx \  
--joiner=./sherpa-onnx-streaming-zipformer-zh-14M-2023-02-23/joiner-epoch-99-avg-1.onnx
```

**Hint:** If your system is Linux (including embedded Linux), you can also use *sherpa-onnx-alsa* to do real-time speech recognition with your microphone if *sherpa-onnx-microphone* does not work for you.

## csukuangfj/sherpa-onnx-streaming-zipformer-en-20M-2023-02-17 (English)

**Hint:** It is a small model.

This model is from

<https://huggingface.co/desh2608/icefall-asr-librispeech-pruned-transducer-stateless7-streaming-small>

which supports only English as it is trained on the [LibriSpeech](#) corpus.

In the following, we describe how to download it and use it with [sherpa-onnx](#).

### Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
˓→streaming-zipformer-en-20M-2023-02-17.tar.bz2

# For Chinese users, you can use the following mirror
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
˓→streaming-zipformer-en-20M-2023-02-17.tar.bz2

tar xvf sherpa-onnx-streaming-zipformer-en-20M-2023-02-17.tar.bz2
rm sherpa-onnx-streaming-zipformer-en-20M-2023-02-17.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of \*.onnx files below.

```
sherpa-onnx-streaming-zipformer-en-20M-2023-02-17 fangjun$ ls -lh *.onnx
-rw-r--r-- 1 fangjun staff 527K Sep 10 17:06 decoder-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 fangjun staff 2.0M Sep 10 17:06 decoder-epoch-99-avg-1.onnx
-rw-r--r-- 1 fangjun staff 41M Sep 10 17:06 encoder-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 fangjun staff 85M Sep 10 17:06 encoder-epoch-99-avg-1.onnx
-rw-r--r-- 1 fangjun staff 253K Sep 10 17:06 joiner-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 fangjun staff 1.0M Sep 10 17:06 joiner-epoch-99-avg-1.onnx
```

### Decode a single wave file

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

## fp32

The following code shows how to use fp32 models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
--tokens=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/tokens.txt \
--encoder=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/encoder-epoch-99-avg-1.
˓→onnx \
--decoder=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/decoder-epoch-99-avg-1.
˓→onnx \
--joiner=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/joiner-epoch-99-avg-1.
˓→onnx \
./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/test_wavs/0.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx.exe` for Windows.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./
˓→build/bin/sherpa-onnx --tokens=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/
˓→tokens.txt --encoder=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/encoder-epoch-
˓→99-avg-1.onnx --decoder=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/decoder-
˓→epoch-99-avg-1.onnx --joiner=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/
˓→joiner-epoch-99-avg-1.onnx ./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/test_
˓→wavs/0.wav

OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_
˓→dim=80), model_config=OnlineModelConfig(transducer=OnlineTransducerModelConfig(encoder=
˓→"./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/encoder-epoch-99-avg-1.onnx",_
˓→decoder="./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/decoder-epoch-99-avg-1.
˓→onnx", joiner="./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/joiner-epoch-99-avg-
˓→1.onnx"), paraformer=OnlineParaformerModelConfig(encoder="", decoder=""), tokens="./
˓→sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/tokens.txt", num_threads=1,_
˓→debug=False, provider="cpu", model_type=""), lm_config=OnlineLMConfig(model="",_
˓→scale=0.5), endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_
˓→nonsilence=False, min_trailing_silence=2.4, min_utterance_length=0),_
˓→rule2=EndpointRule(must_contain_nonsilence=True, min_trailing_silence=1.2, min_
˓→utterance_length=0), rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_
˓→silence=0, min_utterance_length=20)), enable_endpoint=True, max_active_paths=4,_
˓→context_score=1.5, decoding_method="greedy_search")
./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/test_wavs/0.wav
Elapsed seconds: 0.32, Real time factor (RTF): 0.049
THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID QUARTER OF THE BRAFFLELS
{"is_final":false,"segment":0,"start_time":0.0,"text":" THE YELLOW LAMPS WOULD LIGHT UP_
˓→HERE AND THERE THE SQUALID QUARTER OF THE BRAFFLELS","timestamps":[2.04, 2.16, 2.28,_
˓→2.36, 2.52, 2.64, 2.68, 2.76, 2.92, 3.08, 3.40, 3.60, 3.72, 3.88, 4.12, 4.48, 4.64, 4.
˓→68, 4.84, 4.96, 5.16, 5.20, 5.32, 5.36, 5.60, 5.72, 5.92, 5.96, 6.08, 6.24, 6.36, 6.52]
˓→,"tokens":[" THE", " YE", " LL", " OW", " LA", " M", " P", " S", " WOULD", " LIGHT", " UP", " HE", " RE
˓→", " AND", " THERE", " THE", " S", " QUA", " LI", " D", " ", " QUA", " R", " TER", " OF", " THE", " B", " RA
˓→", " FF", " L", " EL", " S"]}
```

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**int8**

The following code shows how to use int8 models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
--tokens=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/tokens.txt \
--encoder=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/encoder-epoch-99-avg-1.
→ int8.onnx \
--decoder=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/decoder-epoch-99-avg-1.
→ onnx \
--joiner=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/joiner-epoch-99-avg-1.
→ int8.onnx \
./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/test_wavs/0.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx.exe` for Windows.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./
→ build/bin/sherpa-onnx --tokens=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/
→ tokens.txt --encoder=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/encoder-epoch-
→ 99-avg-1.int8.onnx --decoder=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/
→ decoder-epoch-99-avg-1.onnx --joiner=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-
→ 17/joiner-epoch-99-avg-1.int8.onnx ./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/
→ test_wavs/0.wav

OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_
→ dim=80), model_config=OnlineModelConfig(transducer=OnlineTransducerModelConfig(encoder=
→ "./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/encoder-epoch-99-avg-1.int8.onnx",
→ decoder="./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/decoder-epoch-99-avg-1.
→ onnx", joiner="./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/joiner-epoch-99-avg-
→ 1.int8.onnx"), paraformer=OnlineParaformerModelConfig(encoder="", decoder=""), tokens=
→ "./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/tokens.txt", num_threads=1,
→ debug=False, provider="cpu", model_type=""), lm_config=OnlineLMConfig(model="",
→ scale=0.5), endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_
→ nonsilence=False, min_trailing_silence=2.4, min_utterance_length=0),
→ rule2=EndpointRule(must_contain_nonsilence=True, min_trailing_silence=1.2, min_
→ utterance_length=0), rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_
→ silence=0, min_utterance_length=20)), enable_endpoint=True, max_active_paths=4,
→ context_score=1.5, decoding_method="greedy_search")
./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/test_wavs/0.wav
Elapsed seconds: 0.25, Real time factor (RTF): 0.038
THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID QUARTER OF THE BRAFFLS
{"is_final":false,"segment":0,"start_time":0.0,"text":" THE YELLOW LAMPS WOULD LIGHT UP
→ HERE AND THERE THE SQUALID QUARTER OF THE BRAFFLS","timestamps":[2.04, 2.20, 2.28, 2.
→ 36, 2.52, 2.64, 2.68, 2.76, 2.92, 3.08, 3.40, 3.60, 3.72, 3.88, 4.12, 4.48, 4.64, 4.68,
→ 4.84, 4.96, 5.16, 5.20, 5.32, 5.36, 5.60, 5.72, 5.92, 5.96, 6.08, 6.24, 6.36], "tokens"
→ :[" THE", " YE", "LL", "OW", " LA", "M", "P", "S", " WOULD", " LIGHT", " UP", " HE", "RE", " AND",
→ " THERE", " THE", " S", " QUA", "LI", "D", " ", "QUA", "R", "TER", " OF", " THE", " B", "RA", "FF", "361
→ , "S"]}
```

## Real-time speech recognition from a microphone

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-microphone \
--tokens=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/tokens.txt \
--encoder=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/encoder-epoch-99-avg-1.
˓→onnx \
--decoder=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/decoder-epoch-99-avg-1.
˓→onnx \
--joiner=./sherpa-onnx-streaming-zipformer-en-20M-2023-02-17/joiner-epoch-99-avg-1.onnx
```

**Hint:** If your system is Linux (including embedded Linux), you can also use *sherpa-onnx-alsa* to do real-time speech recognition with your microphone if *sherpa-onnx-microphone* does not work for you.

## Conformer-transducer-based Models

**Hint:** Please refer to *Installation* to install *sherpa-onnx* before you read this section.

### csukuangfj/sherpa-onnx-streaming-conformer-zh-2023-05-23 (Chinese)

This model is converted from

[https://huggingface.co/luomingshuang/icefall\\_asr\\_wenetspeech\\_pruned\\_transducer\\_stateless5\\_streaming](https://huggingface.co/luomingshuang/icefall_asr_wenetspeech_pruned_transducer_stateless5_streaming)

which supports only Chinese as it is trained on the [WenetSpeech](#) corpus.

You can find the training code at

[https://github.com/k2-fsa/icefall/tree/master/egs/wenetspeech/ASR/pruned\\_transducer\\_stateless5](https://github.com/k2-fsa/icefall/tree/master/egs/wenetspeech/ASR/pruned_transducer_stateless5)

In the following, we describe how to download it and use it with *sherpa-onnx*.

#### Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
˓→streaming-conformer-zh-2023-05-23.tar.bz2

# For Chinese users, please use the following mirror
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
˓→streaming-conformer-zh-2023-05-23.tar.bz2
```

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```
tar xvf sherpa-onnx-streaming-conformer-zh-2023-05-23.tar.bz2
rm sherpa-onnx-streaming-conformer-zh-2023-05-23.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of \*.onnx files below.

```
sherpa-onnx-streaming-conformer-zh-2023-05-23 fangjun$ ls -lh *.onnx
-rw-r--r-- 1 fangjun staff 11M May 23 14:44 decoder-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 fangjun staff 12M May 23 14:44 decoder-epoch-99-avg-1.onnx
-rw-r--r-- 1 fangjun staff 160M May 23 14:46 encoder-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 fangjun staff 345M May 23 14:47 encoder-epoch-99-avg-1.onnx
-rw-r--r-- 1 fangjun staff 2.7M May 23 14:44 joiner-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 fangjun staff 11M May 23 14:44 joiner-epoch-99-avg-1.onnx
```

## Decode a single wave file

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

### fp32

The following code shows how to use fp32 models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
--tokens=./sherpa-onnx-streaming-conformer-zh-2023-05-23/tokens.txt \
--encoder=./sherpa-onnx-streaming-conformer-zh-2023-05-23/encoder-epoch-99-avg-1.onnx \
--decoder=./sherpa-onnx-streaming-conformer-zh-2023-05-23/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-streaming-conformer-zh-2023-05-23/joiner-epoch-99-avg-1.onnx \
./sherpa-onnx-streaming-conformer-zh-2023-05-23/test_wavs/0.wav
```

**Note:** Please use ./build/bin/Release/sherpa-onnx.exe for Windows.

You should see the following output:

```
OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_
dim=80), model_config=OnlineTransducerModelConfig(encoder_filename="./sherpa-onnx-
streaming-conformer-zh-2023-05-23/encoder-epoch-99-avg-1.onnx", decoder_filename="./
sherpa-onnx-streaming-conformer-zh-2023-05-23/decoder-epoch-99-avg-1.onnx", joiner_
filename="./sherpa-onnx-streaming-conformer-zh-2023-05-23/joiner-epoch-99-avg-1.onnx",_
tokens="./sherpa-onnx-streaming-conformer-zh-2023-05-23/tokens.txt", num_threads=2,_
debug=False), lm_config=OnlineLMConfig(model="", scale=0.5), endpoint_
config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_trailing_
silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_nonsilence=True,_
min_trailing_silence=1.2, min_utterance_length=0), rule3=EndpointRule(must_contain_
nonsilence=False, min_trailing_silence=0, min_utterance_length=20)), enable_
endpoint=True, max_active_paths=4, decoding_method="greedy_search") (continues on next page)
```

(continued from previous page)

```
sampling rate of input file: 16000
wav filename: ./sherpa-onnx-streaming-conformer-zh-2023-05-23/test_wavs/0.wav
wav duration (s): 5.611
Started
Done!
Recognition result for ./sherpa-onnx-streaming-conformer-zh-2023-05-23/test_wavs/0.wav:
{"is_final":false,"segment":0,"start_time":0.0,"text":"","timestamps":"[0.00, 0.48, 0.76,
← 0.88, 1.08, 1.24, 2.00, 2.04, 2.16, 2.36, 2.56, 2.72, 2.92, 3.36, 3.44, 3.64, 3.72, 3.
← 84, 3.96, 4.04, 4.16, 4.28, 4.48, 4.64, 4.84, 5.16]","tokens":["","","","","","","","","","","",
←","","","","","","","","","","","","","","","",""]}
num threads: 2
decoding method: greedy_search
Elapsed seconds: 0.559 s
Real time factor (RTF): 0.559 / 5.611 = 0.100
```

**Caution:** If you use Windows and get encoding issues, please run:

```
CHCP 65001
```

in your commandline.

## int8

The following code shows how to use int8 models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
--tokens=./sherpa-onnx-streaming-conformer-zh-2023-05-23/tokens.txt \
--encoder=./sherpa-onnx-streaming-conformer-zh-2023-05-23/encoder-epoch-99-avg-1.int8.
← onnx \
--decoder=./sherpa-onnx-streaming-conformer-zh-2023-05-23/decoder-epoch-99-avg-1.int8.
← onnx \
--joiner=./sherpa-onnx-streaming-conformer-zh-2023-05-23/joiner-epoch-99-avg-1.int8.
← onnx \
./sherpa-onnx-streaming-conformer-zh-2023-05-23/test_wavs/0.wav
```

**Note:** Please use ./build/bin/Release/sherpa-onnx.exe for Windows.

You should see the following output:

```
OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_
← dim=80), model_config=OnlineTransducerModelConfig(encoder_filename="./sherpa-onnx-
← streaming-conformer-zh-2023-05-23/encoder-epoch-99-avg-1.int8.onnx", decoder_filename=
← "./sherpa-onnx-streaming-conformer-zh-2023-05-23/decoder-epoch-99-avg-1.int8.onnx",
← joiner_filename="./sherpa-onnx-streaming-conformer-zh-2023-05-23/joiner-epoch-99-avg-1.
← int8.onnx", tokens="./sherpa-onnx-streaming-conformer-zh-2023-05-23/tokens.txt", num_
← threads=2, debug=False), lm_config=OnlineLMConfig(model="", scale=0.5), endpoint_
← config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_trailing_
← silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_nonsilence=True, page_
← min_trailing_silence=1.2, min_utterance_length=0), rule3=EndpointRule(must_contain_
← nonsilence=False, min_trailing_silence=0, min_utterance_length=20)), enable_
← endpoint=True, max_active_paths=4, decoding_method="greedy_search")
```

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```
sampling rate of input file: 16000
wav filename: ./sherpa-onnx-streaming-conformer-zh-2023-05-23/test_wavs/0.wav
wav duration (s): 5.611
Started
Done!
Recognition result for ./sherpa-onnx-streaming-conformer-zh-2023-05-23/test_wavs/0.wav:
{"is_final":false,"segment":0,"start_time":0.0,"text":"","timestamps":"[0.00, 0.48, 0.72,
← 0.88, 1.08, 1.24, 2.00, 2.04, 2.16, 2.28, 2.56, 2.72, 2.92, 3.36, 3.44, 3.60, 3.72, 3.
← 84, 3.92, 4.04, 4.16, 4.28, 4.48, 4.60, 4.84, 5.16]","tokens":["","","","","","","","","","","",
← "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", ""}]}
num threads: 2
decoding method: greedy_search
Elapsed seconds: 0.493 s
Real time factor (RTF): 0.493 / 5.611 = 0.088
```

**Caution:** If you use Windows and get encoding issues, please run:

CHCP 65001

in your commandline.

### Real-time speech recognition from a microphone

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-microphone \
--tokens=./sherpa-onnx-streaming-conformer-zh-2023-05-23/tokens.txt \
--encoder=./sherpa-onnx-streaming-conformer-zh-2023-05-23/encoder-epoch-99-avg-1.onnx \
--decoder=./sherpa-onnx-streaming-conformer-zh-2023-05-23/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-streaming-conformer-zh-2023-05-23/joiner-epoch-99-avg-1.onnx
```

**Hint:** If your system is Linux (including embedded Linux), you can also use *sherpa-onnx-alsa* to do real-time speech recognition with your microphone if *sherpa-onnx-microphone* does not work for you.

## LSTM-transducer-based Models

---

**Hint:** Please refer to [Installation](#) to install `sherpa-onnx` before you read this section.

---

### csukuangfj/sherpa-onnx-lstm-en-2023-02-17 (English)

This model trained using the [GigaSpeech](#) and the [LibriSpeech](#) dataset.

Please see <https://github.com/k2-fsa/icefall/pull/558> for how the model is trained.

You can find the training code at

[https://github.com/k2-fsa/icefall/tree/master/egs/librispeech/ASR/lstm\\_transducer\\_stateless2](https://github.com/k2-fsa/icefall/tree/master/egs/librispeech/ASR/lstm_transducer_stateless2)

In the following, we describe how to download it and use it with `sherpa-onnx`.

#### Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-lstm-
-en-2023-02-17.tar.bz2

# For Chinese users, please use the following mirror
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
-lstm-en-2023-02-17.tar.bz2

tar xvf sherpa-onnx-lstm-en-2023-02-17.tar.bz2
rm sherpa-onnx-lstm-en-2023-02-17.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of `*.onnx` files below.

```
sherpa-onnx-lstm-en-2023-02-17$ ls -lh *.onnx
-rw-r--r-- 1 kuangfangjun root  1.3M Mar 31 22:41 decoder-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 kuangfangjun root  2.0M Mar 31 22:41 decoder-epoch-99-avg-1.onnx
-rw-r--r-- 1 kuangfangjun root  80M Mar 31 22:41 encoder-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 kuangfangjun root 319M Mar 31 22:41 encoder-epoch-99-avg-1.onnx
-rw-r--r-- 1 kuangfangjun root 254K Mar 31 22:41 joiner-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 kuangfangjun root 1003K Mar 31 22:41 joiner-epoch-99-avg-1.onnx
```

## Decode a single wave file

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

### fp32

The following code shows how to use fp32 models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
--tokens=./sherpa-onnx-lstm-en-2023-02-17/tokens.txt \
--encoder=./sherpa-onnx-lstm-en-2023-02-17/encoder-epoch-99-avg-1.onnx \
--decoder=./sherpa-onnx-lstm-en-2023-02-17/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-lstm-en-2023-02-17/joiner-epoch-99-avg-1.onnx \
./sherpa-onnx-lstm-en-2023-02-17/test_wavs/0.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx.exe` for Windows.

You should see the following output:

```
OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_
˓dim=80), model_config=OnlineTransducerModelConfig(encoder_filename="./sherpa-onnx-lstm-
˓en-2023-02-17/encoder-epoch-99-avg-1.onnx", decoder_filename="./sherpa-onnx-lstm-en-
˓2023-02-17/decoder-epoch-99-avg-1.onnx", joiner_filename="./sherpa-onnx-lstm-en-2023-
˓02-17/joiner-epoch-99-avg-1.onnx", tokens="./sherpa-onnx-lstm-en-2023-02-17/tokens.txt
˓", num_threads=2, debug=False), endpoint_config=EndpointConfig(rule1=EndpointRule(must_
˓contain_nonsilence=False, min_trailing_silence=2.4, min_utterance_length=0),
˓rule2=EndpointRule(must_contain_nonsilence=True, min_trailing_silence=1.2, min_
˓utterance_length=0), rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_
˓silence=0, min_utterance_length=20)), enable_endpoint=True,
max_active_paths=4, decoding_method="greedy_search")
2023-03-31 22:53:22.120185169 [E:onnxruntime:, env.cc:251 ThreadMain] pthread_
˓setaffinity_np failed for thread: 576406, index: 16, mask: {17, 53, }, error code: 22
˓error msg: Invalid argument. Specify the number of threads explicitly so the affinity
˓is not set.
2023-03-31 22:53:22.120183162 [E:onnxruntime:, env.cc:251 ThreadMain] pthread_
˓setaffinity_np failed for thread: 576405, index: 15, mask: {16, 52, }, error code: 22
˓error msg: Invalid argument. Specify the number of threads explicitly so the affinity
˓is not set.
sampling rate of input file: 16000
wav filename: ./sherpa-onnx-lstm-en-2023-02-17/test_wavs/0.wav
wav duration (s): 6.625
Started
Done!
Recognition result for ./sherpa-onnx-lstm-en-2023-02-17/test_wavs/0.wav:
AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID_
˓QUARTER OF THE BROTHELS
```

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```
num threads: 2
decoding method: greedy_search
Elapsed seconds: 2.927 s
Real time factor (RTF): 2.927 / 6.625 = 0.442
```

## int8

The following code shows how to use int8 models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
--tokens=./sherpa-onnx-lstm-en-2023-02-17/tokens.txt \
--encoder=./sherpa-onnx-lstm-en-2023-02-17/encoder-epoch-99-avg-1.int8.onnx \
--decoder=./sherpa-onnx-lstm-en-2023-02-17/decoder-epoch-99-avg-1.int8.onnx \
--joiner=./sherpa-onnx-lstm-en-2023-02-17/joiner-epoch-99-avg-1.int8.onnx \
./sherpa-onnx-lstm-en-2023-02-17/test_wavs/0.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx.exe` for Windows.

You should see the following output:

```
OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_
˓dim=80), model_config=OnlineTransducerModelConfig(encoder_filename="./sherpa-onnx-lstm-
˓en-2023-02-17/encoder-epoch-99-avg-1.int8.onnx", decoder_filename="./sherpa-onnx-lstm-
˓en-2023-02-17/decoder-epoch-99-avg-1.int8.onnx", joiner_filename="./sherpa-onnx-lstm-
˓en-2023-02-17/joiner-epoch-99-avg-1.int8.onnx", tokens="./sherpa-onnx-lstm-en-2023-02-
˓17/tokens.txt", num_threads=2, debug=False), endpoint_
˓config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_trailing_
˓silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_nonsilence=True,_
˓min_trailing_silence=1.2, min_utterance_length=0), rule3=EndpointRule(must_contain_
˓nonsilence=False, min_trailing_silence=0, min_utterance_length=20)), enable_
˓endpoint=True, max_active_paths=4, decoding_method="greedy_search")
2023-03-31 22:55:46.608941959 [E:onnxruntime:, env.cc:251 ThreadMain] pthread_
˓setaffinity_np failed for thread: 578689, index: 16, mask: {17, 53, }, error code: 22
˓error msg: Invalid argument. Specify the number of threads explicitly so the affinity_
˓is not set.
2023-03-31 22:55:46.608939862 [E:onnxruntime:, env.cc:251 ThreadMain] pthread_
˓setaffinity_np failed for thread: 578688, index: 15, mask: {16, 52, }, error code: 22
˓error msg: Invalid argument. Specify the number of threads explicitly so the affinity_
˓is not set.
sampling rate of input file: 16000
wav filename: ./sherpa-onnx-lstm-en-2023-02-17/test_wavs/0.wav
wav duration (s): 6.625
Started
Done!
Recognition result for ./sherpa-onnx-lstm-en-2023-02-17/test_wavs/0.wav:
AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID_
˓QUARTER OF THE BROTHELS
```

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```
num threads: 2
decoding method: greedy_search
Elapsed seconds: 1.009 s
Real time factor (RTF): 1.009 / 6.625 = 0.152
```

## Real-time speech recognition from a microphone

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-microphone \
--tokens=./sherpa-onnx-lstm-en-2023-02-17/tokens.txt \
--encoder=./sherpa-onnx-lstm-en-2023-02-17/encoder-epoch-99-avg-1.onnx \
--decoder=./sherpa-onnx-lstm-en-2023-02-17/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-lstm-en-2023-02-17/joiner-epoch-99-avg-1.onnx
```

**Hint:** If your system is Linux (including embedded Linux), you can also use *sherpa-onnx-alsa* to do real-time speech recognition with your microphone if *sherpa-onnx-microphone* does not work for you.

## csukuangfj/sherpa-onnx-lstm-zh-2023-02-20 (Chinese)

This is a model trained using the [WenetSpeech](#) dataset.

Please see <https://github.com/k2-fsa/icefall/pull/595> for how the model is trained.

In the following, we describe how to download it and use it with *sherpa-onnx*.

### Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-lstm-
zh-2023-02-20.tar.bz2

# For Chinese users, you can use the following mirror
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
lstm-zh-2023-02-20.tar.bz2

tar xvf sherpa-onnx-lstm-zh-2023-02-20.tar.bz2
rm sherpa-onnx-lstm-zh-2023-02-20.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of \*.onnx files below.

```
sherpa-onnx-lstm-zh-2023-02-20$ ls -lh *.onnx
-rw-r--r-- 1 kuangfangjun root 12M Mar 31 20:55 decoder-epoch-11-avg-1.int8.onnx
-rw-r--r-- 1 kuangfangjun root 12M Mar 31 20:55 decoder-epoch-11-avg-1.onnx
-rw-r--r-- 1 kuangfangjun root 80M Mar 31 20:55 encoder-epoch-11-avg-1.int8.onnx
```

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```
-rw-r--r-- 1 kuangfangjun root 319M Mar 31 20:55 encoder-epoch-11-avg-1.onnx
-rw-r--r-- 1 kuangfangjun root 2.8M Mar 31 20:55 joiner-epoch-11-avg-1.int8.onnx
-rw-r--r-- 1 kuangfangjun root 11M Mar 31 20:55 joiner-epoch-11-avg-1.onnx
```

## Decode a single wave file

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

### fp32

The following code shows how to use fp32 models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
--tokens=./sherpa-onnx-lstm-zh-2023-02-20/tokens.txt \
--encoder=./sherpa-onnx-lstm-zh-2023-02-20/encoder-epoch-11-avg-1.onnx \
--decoder=./sherpa-onnx-lstm-zh-2023-02-20/decoder-epoch-11-avg-1.onnx \
--joiner=./sherpa-onnx-lstm-zh-2023-02-20/joiner-epoch-11-avg-1.onnx \
./sherpa-onnx-lstm-zh-2023-02-20/test_wavs/0.wav
```

**Note:** Please use ./build/bin/Release/sherpa-onnx.exe for Windows.

**Caution:** If you use Windows and get encoding issues, please run:

```
CHCP 65001
```

in your commandline.

You should see the following output:

```
OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_
dim=80), model_config=OnlineTransducerModelConfig(encoder_filename="./sherpa-onnx-lstm-
zh-2023-02-20/encoder-epoch-11-avg-1.onnx", decoder_filename="./sherpa-onnx-lstm-zh-
2023-02-20/decoder-epoch-11-avg-1.onnx", joiner_filename="./sherpa-onnx-lstm-zh-2023-
02-20/joiner-epoch-11-avg-1.onnx", tokens="./sherpa-onnx-lstm-zh-2023-02-20/tokens.txt
", num_threads=2, debug=False), endpoint_config=EndpointConfig(rule1=EndpointRule(must_
contain_nonsilence=False, min_trailing_silence=2.4, min_utterance_length=0),_
rule2=EndpointRule(must_contain_nonsilence=True, min_trailing_silence=1.2, min_
utterance_length=0), rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_
silence=0, min_utterance_length=20)), enable_endpoint=True, max_active_paths=4,_
decoding_method="greedy_search")
2023-03-31 22:58:59.348229346 [E:onnxruntime:, env.cc:251 ThreadMain] pthread_
setaffinity_np failed for thread: 578800, index: 15, mask: {16, 52, }, error code: 22,_
error msg: Invalid argument. Specify the number of threads explicitly so the affinity_
is not set.
```

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```
2023-03-31 22:58:59.348231417 [E:onnxruntime:, env.cc:251 ThreadMain] pthread_
↳ setaffinity_np failed for thread: 578801, index: 16, mask: {17, 53, }, error code: 22
↳ error msg: Invalid argument. Specify the number of threads explicitly so the affinity
↳ is not set.
sampling rate of input file: 16000
wav filename: ./sherpa-onnx-lstm-zh-2023-02-20/test_wavs/0.wav
wav duration (s): 5.611
Started
Done!
Recognition result for ./sherpa-onnx-lstm-zh-2023-02-20/test_wavs/0.wav:

num threads: 2
decoding method: greedy_search
Elapsed seconds: 3.030 s
Real time factor (RTF): 3.030 / 5.611 = 0.540
```

## int8

The following code shows how to use int8 models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
--tokens=./sherpa-onnx-lstm-zh-2023-02-20/tokens.txt \
--encoder=./sherpa-onnx-lstm-zh-2023-02-20/encoder-epoch-11-avg-1.int8.onnx \
--decoder=./sherpa-onnx-lstm-zh-2023-02-20/decoder-epoch-11-avg-1.int8.onnx \
--joiner=./sherpa-onnx-lstm-zh-2023-02-20/joiner-epoch-11-avg-1.int8.onnx \
./sherpa-onnx-lstm-zh-2023-02-20/test_wavs/0.wav
```

**Note:** Please use ./build/bin/Release/sherpa-onnx.exe for Windows.

**Caution:** If you use Windows and get encoding issues, please run:

CHCP 65001

in your commandline.

You should see the following output:

```
OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_
↳ dim=80), model_config=OnlineTransducerModelConfig(encoder_filename="./sherpa-onnx-lstm-
↳ zh-2023-02-20/encoder-epoch-11-avg-1.int8.onnx", decoder_filename="./sherpa-onnx-lstm-
↳ zh-2023-02-20/decoder-epoch-11-avg-1.int8.onnx", joiner_filename="./sherpa-onnx-lstm-
↳ zh-2023-02-20/joiner-epoch-11-avg-1.int8.onnx", tokens="./sherpa-onnx-lstm-zh-2023-02-
↳ 20/tokens.txt", num_threads=2, debug=False), endpoint_
↳ config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_trailing_
↳ silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_nonsilence=True,_
↳ min_trailing_silence=1.2, min_utterance_length=0), rule3=EndpointRule(must_contain_
↳ nonsilence=False, min_trailing_silence=0, min_utterance_length=20)), enable_
↳ endpoint=True, max_active_paths=4, decoding_method="greedy_search")
```

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```
2023-03-31 23:01:05.737519659 [E:onnxruntime:, env.cc:251 ThreadMain] pthread_
↳ setaffinity_np failed for thread: 578880, index: 15, mask: {16, 52, }, error code: 22
↳ error msg: Invalid argument. Specify the number of threads explicitly so the affinity
↳ is not set.
2023-03-31 23:01:05.737521655 [E:onnxruntime:, env.cc:251 ThreadMain] pthread_
↳ setaffinity_np failed for thread: 578881, index: 16, mask: {17, 53, }, error code: 22
↳ error msg: Invalid argument. Specify the number of threads explicitly so the affinity
↳ is not set.
sampling rate of input file: 16000
wav filename: ./sherpa-onnx-lstm-zh-2023-02-20/test_wavs/0.wav
wav duration (s): 5.611
Started
Done!
Recognition result for ./sherpa-onnx-lstm-zh-2023-02-20/test_wavs/0.wav:

num threads: 2
decoding method: greedy_search
Elapsed seconds: 1.091 s
Real time factor (RTF): 1.091 / 5.611 = 0.194
```

## Real-time speech recognition from a microphone

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-microphone \
  --tokens=./sherpa-onnx-lstm-zh-2023-02-20/tokens.txt \
  --encoder=./sherpa-onnx-lstm-zh-2023-02-20/encoder-epoch-11-avg-1.onnx \
  --decoder=./sherpa-onnx-lstm-zh-2023-02-20/decoder-epoch-11-avg-1.onnx \
  --joiner=./sherpa-onnx-lstm-zh-2023-02-20/joiner-epoch-11-avg-1.onnx
```

---

**Hint:** If your system is Linux (including embedded Linux), you can also use *sherpa-onnx-alsa* to do real-time speech recognition with your microphone if *sherpa-onnx-microphone* does not work for you.

---

### 8.22.2 Online paraformer models

This section lists available online paraformer models.

#### Paraformer models

---

**Hint:** Please refer to *Installation* to install *sherpa-onnx* before you read this section.

---

## csukuangfj/sherpa-onnx-streaming-paraformer-bilingual-zh-en (Chinese + English)

**Note:** This model does not support timestamps. It is a bilingual model, supporting both Chinese and English. ()

This model is converted from

[https://www.modelscope.cn/models/damo/speech\\_paraformer\\_asr\\_nat-zh-cn-16k-common-vocab8404-online/summary](https://www.modelscope.cn/models/damo/speech_paraformer_asr_nat-zh-cn-16k-common-vocab8404-online/summary)

The code for converting can be found at

<https://huggingface.co/csukuangfj/streaming-paraformer-zh>

In the following, we describe how to download it and use it with `sherpa-onnx`.

### Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
      ↪streaming-paraformer-bilingual-zh-en.tar.bz2

# For Chinese users
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
      ↪streaming-paraformer-bilingual-zh-en.tar.bz2

tar xvf sherpa-onnx-streaming-paraformer-bilingual-zh-en.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of `*.onnx` files below.

```
sherpa-onnx-streaming-paraformer-bilingual-zh-en fangjun$ ls -lh *.onnx
-rw-r--r-- 1 fangjun staff 68M Aug 14 09:53 decoder.int8.onnx
-rw-r--r-- 1 fangjun staff 218M Aug 14 09:55 decoder.onnx
-rw-r--r-- 1 fangjun staff 158M Aug 14 09:54 encoder.int8.onnx
-rw-r--r-- 1 fangjun staff 607M Aug 14 09:57 encoder.onnx
```

### Decode a single wave file

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

## fp32

The following code shows how to use fp32 models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
--tokens=./sherpa-onnx-streaming-paraformer-bilingual-zh-en/tokens.txt \
--paraformer-encoder=./sherpa-onnx-streaming-paraformer-bilingual-zh-en/encoder.onnx \
--paraformer-decoder=./sherpa-onnx-streaming-paraformer-bilingual-zh-en/decoder.onnx \
./sherpa-onnx-streaming-paraformer-bilingual-zh-en/test_wavs/0.wav
```

**Note:** Please use ./build/bin/Release/sherpa-onnx.exe for Windows.

**Caution:** If you use Windows and get encoding issues, please run:

```
CHCP 65001
```

in your commandline.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./
build/bin/sherpa-onnx --tokens=./sherpa-onnx-streaming-paraformer-bilingual-zh-en/
tokens.txt --paraformer-encoder=./sherpa-onnx-streaming-paraformer-bilingual-zh-en/
encoder.onnx --paraformer-decoder=./sherpa-onnx-streaming-paraformer-bilingual-zh-en/
decoder.onnx ./sherpa-onnx-streaming-paraformer-bilingual-zh-en/test_wavs/0.wav

OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_
dim=80), model_config=OnlineModelConfig(transducer=OnlineTransducerModelConfig(encoder=
'', decoder='', joiner=''), paraformer=OnlineParaformerModelConfig(encoder='./sherpa-
onnx-streaming-paraformer-bilingual-zh-en/encoder.onnx', decoder='./sherpa-onnx-
streaming-paraformer-bilingual-zh-en/decoder.onnx'), tokens='./sherpa-onnx-streaming-
paraformer-bilingual-zh-en/tokens.txt', num_threads=1, debug=False, provider='cpu',_
model_type=''), lm_config=OnlineLMConfig(model='', scale=0.5), endpoint_
config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_trailing_
silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_nonsilence=True,_
min_trailing_silence=1.2, min_utterance_length=0), rule3=EndpointRule(must_contain_
nonsilence=False, min_trailing_silence=0, min_utterance_length=20)), enable_
endpoint=True, max_active_paths=4, context_score=1.5, decoding_method='greedy_search')
./sherpa-onnx-streaming-paraformer-bilingual-zh-en/test_wavs/0.wav
Elapsed seconds: 2.2, Real time factor (RTF): 0.21
monday today day is the day after tomorrow
{"is_final":false,"segment":0,"start_time":0.0,"text":" monday today day is the day_
after tomorrow ","timestamps":[],"tokens":[" "," "," ","mon@@", "day", "today", "day", "is",
" ", " ", " ", "the", "day", "after", "tom@@", "or@@", "row", " ", " ", " ", " "]}{}
```

## int8

The following code shows how to use int8 models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
--tokens=./sherpa-onnx-streaming-paraformer-bilingual-zh-en/tokens.txt \
--paraformer-encoder=./sherpa-onnx-streaming-paraformer-bilingual-zh-en/encoder.int8.
˓→onnx \
--paraformer-decoder=./sherpa-onnx-streaming-paraformer-bilingual-zh-en/decoder.int8.
˓→onnx \
./sherpa-onnx-streaming-paraformer-bilingual-zh-en/test_wavs/0.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx.exe` for Windows.

**Caution:** If you use Windows and get encoding issues, please run:

```
CHCP 65001
```

in your commandline.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./
˓→build/bin/sherpa-onnx --tokens=./sherpa-onnx-streaming-paraformer-bilingual-zh-en/
˓→tokens.txt --paraformer-encoder=./sherpa-onnx-streaming-paraformer-bilingual-zh-en/
˓→encoder.int8.onnx --paraformer-decoder=./sherpa-onnx-streaming-paraformer-bilingual-zh-
˓→en/decoder.int8.onnx ./sherpa-onnx-streaming-paraformer-bilingual-zh-en/test_wavs/0.wav

OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_
˓→dim=80), model_config=OnlineModelConfig(transducer=OnlineTransducerModelConfig(encoder=
˓→'', decoder='', joiner=''), paraformer=OnlineParaformerModelConfig(encoder='./sherpa-
˓→onnx-streaming-paraformer-bilingual-zh-en/encoder.int8.onnx', decoder='./sherpa-onnx-
˓→streaming-paraformer-bilingual-zh-en/decoder.int8.onnx'), tokens='./sherpa-onnx-
˓→streaming-paraformer-bilingual-zh-en/tokens.txt', num_threads=1, debug=False, provider=
˓→'cpu', model_type=''), lm_config=OnlineLMConfig(model='', scale=0.5), endpoint_
˓→config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_trailing_
˓→silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_nonsilence=True,
˓→min_trailing_silence=1.2, min_utterance_length=0), rule3=EndpointRule(must_contain_
˓→nonsilence=False, min_trailing_silence=0, min_utterance_length=20)), enable_
˓→endpoint=True, max_active_paths=4, context_score=1.5, decoding_method="greedy_search")
˓→./sherpa-onnx-streaming-paraformer-bilingual-zh-en/test_wavs/0.wav
Elapsed seconds: 1.6, Real time factor (RTF): 0.15
monday today day is the day after tomorrow
{"is_final":false,"segment":0,"start_time":0.0,"text":" monday today day is the day
˓→after tomorrow ","timestamps":[],"tokens":[" "," "," ","mon@@", "day", "today", "day", "is",
˓→",",",",",", "the", "day", "after", "tom@@", "or@@", "row", "", "", "", "" ]}
```

## Real-time speech recognition from a microphone

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-microphone \
--tokens=./sherpa-onnx-streaming-paraformer-bilingual-zh-en/tokens.txt \
--paraformer-encoder=./sherpa-onnx-streaming-paraformer-bilingual-zh-en/encoder.int8.
˓→onnx \
--paraformer-decoder=./sherpa-onnx-streaming-paraformer-bilingual-zh-en/decoder.int8.
˓→onnx
```

---

**Hint:** If your system is Linux (including embedded Linux), you can also use *sherpa-onnx-alsa* to do real-time speech recognition with your microphone if *sherpa-onnx-microphone* does not work for you.

---

## csukuangfj/sherpa-onnx-streaming-paraformer-trilingual-zh-cantonese-en (Chinese + Cantonese + English)

---

**Note:** This model does not support timestamps. It is a trilingual model, supporting both Chinese and English. ()

---

This model is converted from

[https://modelscope.cn/models/dengcunqin/speech\\_paraformer-large\\_asr\\_nat-zh-cantonese-en-16k-vocab8501-online/files](https://modelscope.cn/models/dengcunqin/speech_paraformer-large_asr_nat-zh-cantonese-en-16k-vocab8501-online/files)

You can find the conversion code after downloading and unzipping the model.

In the following, we describe how to download it and use it with *sherpa-onnx*.

### Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
˓→streaming-paraformer-trilingual-zh-cantonese-en.tar.bz2

# For Chinese users
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
˓→streaming-paraformer-trilingual-zh-cantonese-en.tar.bz2

tar xvf sherpa-onnx-streaming-paraformer-trilingual-zh-cantonese-en.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of \*.onnx files below.

```
sherpa-onnx-streaming-paraformer-trilingual-zh-cantonese-en fangjun$ ls -lh *.onnx
-rw-r--r-- 1 fangjun staff 69M Feb 29 19:44 decoder.int8.onnx
-rw-r--r-- 1 fangjun staff 218M Feb 29 19:44 decoder.onnx
```

(continues on next page)

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```
-rw-r--r-- 1 fangjun staff 159M Feb 29 19:44 encoder.int8.onnx
-rw-r--r-- 1 fangjun staff 607M Feb 29 19:44 encoder.onnx
```

## Decode a single wave file

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

### fp32

The following code shows how to use fp32 models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
--tokens=./sherpa-onnx-streaming-paraformer-trilingual-zh-cantonese-en/tokens.txt \
--paraformer-encoder=./sherpa-onnx-streaming-paraformer-trilingual-zh-cantonese-en/ \
encoder.onnx \
--paraformer-decoder=./sherpa-onnx-streaming-paraformer-trilingual-zh-cantonese-en/ \
decoder.onnx \
./sherpa-onnx-streaming-paraformer-trilingual-zh-cantonese-en/test_wavs/1.wav
```

**Note:** Please use ./build/bin/Release/sherpa-onnx.exe for Windows.

**Caution:** If you use Windows and get encoding issues, please run:

CHCP 65001

in your commandline.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./
build/bin/sherpa-onnx --tokens=./sherpa-onnx-streaming-paraformer-trilingual-zh-
cantonese-en/tokens.txt --paraformer-encoder=./sherpa-onnx-streaming-paraformer-
trilingual-zh-cantonese-en/encoder.int8.onnx --paraformer-decoder=./sherpa-onnx-
streaming-paraformer-trilingual-zh-cantonese-en/decoder.int8.onnx ./sherpa-onnx-
streaming-paraformer-trilingual-zh-cantonese-en/test_wavs/1.wav

OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_
dim=80), model_config=OnlineModelConfig(transducer=OnlineTransducerModelConfig(encoder=
'', decoder='', joiner=''), paraformer=OnlineParaformerModelConfig(encoder='./sherpa-
onnx-streaming-paraformer-trilingual-zh-cantonese-en/encoder.int8.onnx', decoder='./
sherpa-onnx-streaming-paraformer-trilingual-zh-cantonese-en/decoder.int8.onnx'), wenet_
ctc=OnlineWenetCtcModelConfig(model='', chunk_size=16, num_left_chunks=4), zipformer2_
ctc=OnlineZipformer2CtcModelConfig(model=''), tokens='./sherpa-onnx-streaming-
paraformer-trilingual-zh-cantonese-en/tokens.txt', num_threads=1, debug=False, provider='cpu', model_type=''), lm_config=OnlineLmConfig(model='', scale=0.5), endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_trailing_silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_nonsilence=True, min_trailing_silence=1.2, min_utterance_length=0), rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_silence=0, min_utterance_length=20)), enable_endpoint=True, max_active_paths=4, hotwords_score=1.5)
```

(continued from previous page)

```
./sherpa-onnx-streaming-paraformer-trilingual-zh-cantonese-en/test_wavs/1.wav
Elapsed seconds: 0.98, Real time factor (RTF): 0.16

{ "text": "", "tokens": [ "", "", "", "", "", "", "", "", "", "", "", "" ], "timestamps": [ ], "ys_probs": [ ], "lm_probs": [ ], "context_scores": [ ], "segment": 0, "start_time": 0.00, "is_final": false}
```

**int8**

The following code shows how to use int8 models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
--tokens=./sherpa-onnx-streaming-paraformer-trilingual-zh-cantonese-en/tokens.txt \
--paraformer-encoder=./sherpa-onnx-streaming-paraformer-trilingual-zh-cantonese-en/ \
encoder.int8.onnx \
--paraformer-decoder=./sherpa-onnx-streaming-paraformer-trilingual-zh-cantonese-en/ \
decoder.int8.onnx \
./sherpa-onnx-streaming-paraformer-trilingual-zh-cantonese-en/test_wavs/1.wav
```

**Note:** Please use ./build/bin/Release/sherpa-onnx.exe for Windows.

**Caution:** If you use Windows and get encoding issues, please run:

CHCP 65001

in your commandline.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./
build/bin/sherpa-onnx --tokens=./sherpa-onnx-streaming-paraformer-trilingual-zh-
cantonese-en/tokens.txt --paraformer-encoder=./sherpa-onnx-streaming-paraformer-
trilingual-zh-cantonese-en/encoder.int8.onnx --paraformer-decoder=./sherpa-onnx-
streaming-paraformer-trilingual-zh-cantonese-en/decoder.int8.onnx ./sherpa-onnx-
streaming-paraformer-trilingual-zh-cantonese-en/test_wavs/1.wav

OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_
dim=80), model_config=OnlineModelConfig(transducer=OnlineTransducerModelConfig(encoder=
'', decoder='', joiner=''), paraformer=OnlineParaformerModelConfig(encoder='./sherpa-
onnx-streaming-paraformer-trilingual-zh-cantonese-en/encoder.int8.onnx', decoder='./
sherpa-onnx-streaming-paraformer-trilingual-zh-cantonese-en/decoder.int8.onnx'), wenet_
ctc=OnlineWenetCtcModelConfig(model='', chunk_size=16, num_left_chunks=4), zipformer2_
ctc=OnlineZipformer2CtcModelConfig(model=''), tokens='./sherpa-onnx-streaming-
paraformer-trilingual-zh-cantonese-en/tokens.txt', num_threads=1, debug=False,_
provider='cpu', model_type=''), lm_config=OnlineLMConfig(model='', scale=0.5),_
endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_nonsilence=False, min_
trailing_silence=2.4, min_utterance_length=0), rule2=EndpointRule(must_contain_
nonsilence=True, min_trailing_silence=1.2, min_utterance_length=0),_
378rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_silence=0, min_
utterance_length=20)), enable_endpoint=True, max_active_paths=4, hotwords_score=1.5,_
hotwords_file='', decoding_method="greedy_search", blank_penalty=0)
```

(continued from previous page)

```
./sherpa-onnx-streaming-paraformer-trilingual-zh-cantonese-en/test_wavs/1.wav
Elapsed seconds: 0.84, Real time factor (RTF): 0.14

{ "text": "", "tokens": [ "", "", "", "", "", "", "", "", "", "", "", "" ], "timestamps": [ ], "ys_probs": [ ], "lm_probs": [ ], "context_scores": [ ], "segment": 0, "start_time": 0.00, "is_final": false}
```

## Real-time speech recognition from a microphone

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-microphone \
--tokens=./sherpa-onnx-streaming-paraformer-bilingual-zh-en/tokens.txt \
--paraformer-encoder=./sherpa-onnx-streaming-paraformer-trilingual-zh-cantonese-en/encoder.int8.onnx \
--paraformer-decoder=./sherpa-onnx-streaming-paraformer-trilingual-zh-cantonese-en/decoder.int8.onnx
```

**Hint:** If your system is Linux (including embedded Linux), you can also use *sherpa-onnx-alsa* to do real-time speech recognition with your microphone if *sherpa-onnx-microphone* does not work for you.

### 8.22.3 Online CTC models

This section lists available online CTC models.

#### Zipformer-CTC-based Models

**Hint:** Please refer to *Installation* to install *sherpa-onnx* before you read this section.

#### sherpa-onnx-streaming-zipformer-ctc-multi-zh-hans-2023-12-13 (Chinese)

Training code for this model can be found at <https://github.com/k2-fsa/icefall/pull/1369>. It supports only Chinese.

Please refer to [https://github.com/k2-fsa/icefall/tree/master/egs/multi\\_zh-hans/ASR#included-training-sets](https://github.com/k2-fsa/icefall/tree/master/egs/multi_zh-hans/ASR#included-training-sets) for the detailed information about the training data. In total, there are 14k hours of training data.

In the following, we describe how to download it and use it with *sherpa-onnx*.

## Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
˓→streaming-zipformer-ctc-multi-zh-hans-2023-12-13.tar.bz2

# For Chinese users, please use the following mirror
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
˓→streaming-zipformer-ctc-multi-zh-hans-2023-12-13.tar.bz2

tar xvf sherpa-onnx-streaming-zipformer-ctc-multi-zh-hans-2023-12-13.tar.bz2
rm sherpa-onnx-streaming-zipformer-ctc-multi-zh-hans-2023-12-13.tar.bz2
ls -lh sherpa-onnx-streaming-zipformer-ctc-multi-zh-hans-2023-12-13
```

The output is given below:

```
$ ls -lh sherpa-onnx-streaming-zipformer-ctc-multi-zh-hans-2023-12-13
total 654136
-rw-r--r--@ 1 fangjun  staff  28B Dec 13 16:19 README.md
-rw-r--r--@ 1 fangjun  staff  258K Dec 13 16:19 bpe.model
-rw-r--r--@ 1 fangjun  staff  68M Dec 13 16:19 ctc-epoch-20-avg-1-chunk-16-left-128.
˓→int8.onnx
-rw-r--r--@ 1 fangjun  staff  252M Dec 13 16:19 ctc-epoch-20-avg-1-chunk-16-left-128.
˓→onnx
drwxr-xr-x@ 8 fangjun  staff  256B Dec 13 16:19 test_wavs
-rw-r--r--@ 1 fangjun  staff   18K Dec 13 16:19 tokens.txt
```

## Decode a single wave file

---

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

---

### fp32

The following code shows how to use fp32 models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
--zipformer2-ctc-model=./sherpa-onnx-streaming-zipformer-ctc-multi-zh-hans-2023-12-13/
˓→ctc-epoch-20-avg-1-chunk-16-left-128.onnx \
--tokens=./sherpa-onnx-streaming-zipformer-ctc-multi-zh-hans-2023-12-13/tokens.txt \
./sherpa-onnx-streaming-zipformer-ctc-multi-zh-hans-2023-12-13/test_wavs/DEV_
˓→T0000000000.wav
```

---

**Note:** Please use `./build/bin/Release/sherpa-onnx.exe` for Windows.

---

**Caution:** If you use Windows and get encoding issues, please run:

CHCP 65001

in your commandline.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./
→ build/bin/sherpa-onnx --zipformer2-ctc-model=./sherpa-onnx-streaming-zipformer-ctc-
→ multi-zh-hans-2023-12-13/ctc-epoch-20-avg-1-chunk-16-left-128.onnx --tokens=./sherpa-
→ onnx-streaming-zipformer-ctc-multi-zh-hans-2023-12-13/tokens.txt ./sherpa-onnx-
→ streaming-zipformer-ctc-multi-zh-hans-2023-12-13/test_wavs/DEV_T0000000000.wav

OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_
→ dim=80), model_config=OnlineModelConfig(transducer=OnlineTransducerModelConfig(encoder=
→ "", decoder="", joiner=""), paraformer=OnlineParaformerModelConfig(encoder="", decoder=
→ ""), wenet_ctc=OnlineWenetCtcModelConfig(model="", chunk_size=16, num_left_chunks=4),_
→ zipformer2_ctc=OnlineZipformer2CtcModelConfig(model="./sherpa-onnx-streaming-zipformer-
→ ctc-multi-zh-hans-2023-12-13/ctc-epoch-20-avg-1-chunk-16-left-128.onnx"), tokens="./
→ sherpa-onnx-streaming-zipformer-ctc-multi-zh-hans-2023-12-13/tokens.txt", num_
→ threads=1, debug=False, provider="cpu", model_type=""), lm_config=OnlineLMConfig(model=
→ "", scale=0.5), endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_
→ nonsilence=False, min_trailing_silence=2.4, min_utterance_length=0),_
→ rule2=EndpointRule(must_contain_nonsilence=True, min_trailing_silence=1.2, min_
→ utterance_length=0), rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_
→ silence=0, min_utterance_length=20)), enable_endpoint=True, max_active_paths=4,_
→ hotwords_score=1.5, hotwords_file="", decoding_method="greedy_search")
./sherpa-onnx-streaming-zipformer-ctc-multi-zh-hans-2023-12-13/test_wavs/DEV_T0000000000.wav
Elapsed seconds: 0.66, Real time factor (RTF): 0.12

{"is_final":false, "segment":0, "start_time":0.00, "text": " ", "timestamps": [0.00, 0.
→ 52, 0.76, 0.84, 1.08, 1.24, 1.96, 2.04, 2.24, 2.36, 2.56, 2.68, 2.80, 3.28, 3.40, 3.60,
→ 3.72, 3.84, 3.96, 4.04, 4.16, 4.28, 4.36, 4.60, 4.80], "tokens":[" ", "", "", "", "",_
→ "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", ""]}
```

## int8

The following code shows how to use int8 models to decode a wave file:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx \
→ --zipformer2-ctc-model=./sherpa-onnx-streaming-zipformer-ctc-multi-zh-hans-2023-12-13/
→ ctc-epoch-20-avg-1-chunk-16-left-128.int8.onnx \
→ --tokens=./sherpa-onnx-streaming-zipformer-ctc-multi-zh-hans-2023-12-13/tokens.txt \
→ (continues on next page)
```

(continued from previous page)

```
./sherpa-onnx-streaming-zipformer-ctc-multi-zh-hans-2023-12-13/test_wavs/DEV_
↪T0000000000.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx.exe` for Windows.

**Caution:** If you use Windows and get encoding issues, please run:

```
CHCP 65001
```

in your commandline.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./
↪build/bin/sherpa-onnx --zipformer2-ctc-model=./sherpa-onnx-streaming-zipformer-ctc-
↪multi-zh-hans-2023-12-13/ctc-epoch-20-avg-1-chunk-16-left-128.int8.onnx --tokens=./
↪sherpa-onnx-streaming-zipformer-ctc-multi-zh-hans-2023-12-13/tokens.txt ./sherpa-onnx-
↪streaming-zipformer-ctc-multi-zh-hans-2023-12-13/test_wavs/DEV_T0000000000.wav

OnlineRecognizerConfig(feat_config=FeatureExtractorConfig(sampling_rate=16000, feature_
↪dim=80), model_config=OnlineModelConfig(transducer=OnlineTransducerModelConfig(encoder=
↪'', decoder='', joiner=''), paraformer=OnlineParaformerModelConfig(encoder='', decoder=
↪''), wenet_ctc=OnlineWenetCtcModelConfig(model='', chunk_size=16, num_left_chunks=4),_
↪zipformer2_ctc=OnlineZipformer2CtcModelConfig(model='./sherpa-onnx-streaming-zipformer-
↪ctc-multi-zh-hans-2023-12-13/ctc-epoch-20-avg-1-chunk-16-left-128.int8.onnx'), tokens=
↪"./sherpa-onnx-streaming-zipformer-ctc-multi-zh-hans-2023-12-13/tokens.txt", num_
↪threads=1, debug=False, provider="cpu", model_type=''), lm_config=OnlineLMConfig(model=
↪'', scale=0.5), endpoint_config=EndpointConfig(rule1=EndpointRule(must_contain_
↪nonsilence=False, min_trailing_silence=2.4, min_utterance_length=0),_
↪rule2=EndpointRule(must_contain_nonsilence=True, min_trailing_silence=1.2, min_
↪utterance_length=0), rule3=EndpointRule(must_contain_nonsilence=False, min_trailing_
↪silence=0, min_utterance_length=20)), enable_endpoint=True, max_active_paths=4,_
↪hotwords_score=1.5, hotwords_file='', decoding_method="greedy_search")
./sherpa-onnx-streaming-zipformer-ctc-multi-zh-hans-2023-12-13/test_wavs/DEV_T0000000000.
↪wav
Elapsed seconds: 0.44, Real time factor (RTF): 0.078

{"is_final":false, "segment":0, "start_time":0.00, "text": " ", "timestamps": [0.00, 0.
↪52, 0.76, 0.84, 1.04, 1.24, 1.96, 2.04, 2.24, 2.36, 2.56, 2.68, 2.80, 3.28, 3.40, 3.60,
↪3.72, 3.84, 3.96, 4.04, 4.16, 4.28, 4.36, 4.60, 4.84], "tokens":[" ", "", "", "", "", "",
↪"", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", ""]}
```

## Real-time speech recognition from a microphone

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-microphone \
--zipformer2-ctc-model=./sherpa-onnx-streaming-zipformer-ctc-multi-zh-hans-2023-12-13/
˓→ctc-epoch-20-avg-1-chunk-16-left-128.onnx \
--tokens=./sherpa-onnx-streaming-zipformer-ctc-multi-zh-hans-2023-12-13/tokens.txt
```

---

**Hint:** If your system is Linux (including embedded Linux), you can also use *sherpa-onnx-alsa* to do real-time speech recognition with your microphone if *sherpa-onnx-microphone* does not work for you.

---

### 8.22.4 Offline transducer models

This section lists available offline transducer models.

#### Zipformer-transducer-based Models

---

**Hint:** Please refer to *Installation* to install *sherpa-onnx* before you read this section.

---

##### **sherpa-onnx-zipformer-cantonese-2024-03-13 (Cantonese, )**

Training code for this model can be found at <https://github.com/k2-fsa/icefall/pull/1537>. It supports only Cantonese since it is trained on a **‘Canatonese’** dataset. The paper for the dataset can be found at <https://arxiv.org/pdf/2201.02419.pdf>.

In the following, we describe how to download it and use it with *sherpa-onnx*.

#### Download the model

Please use the following commands to download it.

```
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
˓→zipformer-cantonese-2024-03-13.tar.bz2

# For Chinese users, you can use the following mirror
# wget https://hub.nuua.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
˓→zipformer-cantonese-2024-03-13.tar.bz2

tar xf sherpa-onnx-zipformer-cantonese-2024-03-13.tar.bz2
rm sherpa-onnx-zipformer-cantonese-2024-03-13.tar.bz2

ls -lh sherpa-onnx-zipformer-cantonese-2024-03-13
```

You should see the following output:

```
total 340M
-rw-r--r-- 1 1001 127 2.7M Mar 13 09:06 decoder-epoch-45-avg-35.int8.onnx
-rw-r--r-- 1 1001 127 11M Mar 13 09:06 decoder-epoch-45-avg-35.onnx
-rw-r--r-- 1 1001 127 67M Mar 13 09:06 encoder-epoch-45-avg-35.int8.onnx
-rw-r--r-- 1 1001 127 248M Mar 13 09:06 encoder-epoch-45-avg-35.onnx
-rw-r--r-- 1 1001 127 2.4M Mar 13 09:06 joiner-epoch-45-avg-35.int8.onnx
-rw-r--r-- 1 1001 127 9.5M Mar 13 09:06 joiner-epoch-45-avg-35.onnx
drwxr-xr-x 2 1001 127 4.0K Mar 13 09:06 test_wavs
-rw-r--r-- 1 1001 127 42K Mar 13 09:06 tokens.txt
```

## Decode wave files

---

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

---

### fp32

The following code shows how to use fp32 models to decode wave files:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--blank-penalty=1.2 \
--tokens=./sherpa-onnx-zipformer-cantonese-2024-03-13/tokens.txt \
--encoder=./sherpa-onnx-zipformer-cantonese-2024-03-13/encoder-epoch-45-avg-35.onnx \
--decoder=./sherpa-onnx-zipformer-cantonese-2024-03-13/decoder-epoch-45-avg-35.onnx \
--joiner=./sherpa-onnx-zipformer-cantonese-2024-03-13/joiner-epoch-45-avg-35.onnx \
./sherpa-onnx-zipformer-cantonese-2024-03-13/test_wavs/test_wavs_1.wav \
./sherpa-onnx-zipformer-cantonese-2024-03-13/test_wavs/test_wavs_2.wav
```

---

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

---

**Caution:** If you use Windows and get encoding issues, please run:

```
CHCP 65001
```

in your commandline.

You should see the following output:

```
/project/sherpa-onnx/csrc/parse-options.cc:Read:361 sherpa-onnx-offline --blank-
˓penalty=1.2 --tokens=./sherpa-onnx-zipformer-cantonese-2024-03-13/tokens.txt --
˓encoder=./sherpa-onnx-zipformer-cantonese-2024-03-13/encoder-epoch-45-avg-35.onnx --
˓decoder=./sherpa-onnx-zipformer-cantonese-2024-03-13/decoder-epoch-45-avg-35.onnx --
˓joiner=./sherpa-onnx-zipformer-cantonese-2024-03-13/joiner-epoch-45-avg-35.onnx ./
˓sherpa-onnx-zipformer-cantonese-2024-03-13/test_wavs/test_wavs_1.wav ./sherpa-onnx-
˓zipformer-cantonese-2024-03-13/test_wavs/test_wavs_2.wav
```

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```

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000, ↴
    ↴ feature_dim=80), model_ ↴
    ↴ config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="./ ↴
    ↴ sherpa-onnx-zipformer-cantonese-2024-03-13/encoder-epoch-45-avg-35.onnx", decoder_ ↴
    ↴ filename="./sherpa-onnx-zipformer-cantonese-2024-03-13/decoder-epoch-45-avg-35.onnx", ↴
    ↴ joiner_filename="./sherpa-onnx-zipformer-cantonese-2024-03-13/joiner-epoch-45-avg-35. ↴
    ↴ onnx"), paraformer=OfflineParaformerModelConfig(model=""), nemo_ ↴
    ↴ ctc=OfflineNemoEncDecCtcModelConfig(model=""), whisper_ ↴
    ↴ whisper=OfflineWhisperModelConfig(encoder="", decoder="", language="", task="transcribe", ↴
    ↴ tail_paddings=-1), tdnn=OfflineTdnmModelConfig(model=""), zipformer_ ↴
    ↴ ctc=OfflineZipformerCtcModelConfig(model=""), wenet_ ↴
    ↴ ctc=OfflineWenetCtcModelConfig(model=""), tokens="./sherpa-onnx-zipformer-cantonese-2024-03-13/tokens.txt", num_threads=2, debug=False, provider="cpu", model_type=""), lm_ ↴
    ↴ config=OfflineLMConfig(model="", scale=0.5), ctc_fst_decoder_ ↴
    ↴ config=OfflineCtcFstDecoderConfig(graph="", max_active=3000), decoding_method="greedy_search", max_active_paths=4, hotwords_file="", hotwords_score=1.5, blank_penalty=1.2)
Creating recognizer ...
Started
Done!

./sherpa-onnx-zipformer-cantonese-2024-03-13/test_wavs/test_wavs_1.wav
{"text": "", "timestamps": [0.00, 0.88, 1.28, 1.52, 1.84, 2.08, 2.32, 2.56, 2.80, 3.04, ↴
    ↴ 3.20, 3.44, 3.68, 3.92], "tokens":["", "", "", "", "", "", "", "", "", "", "", "", "", "", "", ""]}
---
./sherpa-onnx-zipformer-cantonese-2024-03-13/test_wavs/test_wavs_2.wav
{"text": "", "timestamps": [0.00, 0.64, 0.88, 1.12, 1.28, 1.60, 1.80, 2.16, 2.36, 2.56, 2.88, 3.08, 3.32, 3.44, 3.60], "tokens":["", "", "", "", "", "", "", "", "", "", "", "", "", "", "", ""]}
---
num threads: 2
decoding method: greedy_search
Elapsed seconds: 1.349 s
Real time factor (RTF): 1.349 / 10.320 = 0.131

```

## int8

The following code shows how to use int8 models to decode wave files:

```

cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
    --blank-penalty=1.2 \
    --tokens=./sherpa-onnx-zipformer-cantonese-2024-03-13/tokens.txt \
    --encoder=./sherpa-onnx-zipformer-cantonese-2024-03-13/encoder-epoch-45-avg-35.int8. \
    ↴ onnx \
    --decoder=./sherpa-onnx-zipformer-cantonese-2024-03-13/decoder-epoch-45-avg-35.onnx \
    --joiner=./sherpa-onnx-zipformer-cantonese-2024-03-13/joiner-epoch-45-avg-35.int8.onnx. \
    ↴ \
    ./sherpa-onnx-zipformer-cantonese-2024-03-13/test_wavs/test_wavs_1.wav \

```

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```
./sherpa-onnx-zipformer-cantonese-2024-03-13/test_wavs/test_wavs_2.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

**Caution:** If you use Windows and get encoding issues, please run:

```
CHCP 65001
```

in your commandline.

You should see the following output:

```
/project/sherpa-onnx/csrc/parse-options.cc:Read:361 sherpa-onnx-offline --blank-
˓→penalty=1.2 --tokens=./sherpa-onnx-zipformer-cantonese-2024-03-13/tokens.txt --
˓→encoder=./sherpa-onnx-zipformer-cantonese-2024-03-13/encoder-epoch-45-avg-35.int8.onnx
˓→--decoder=./sherpa-onnx-zipformer-cantonese-2024-03-13/decoder-epoch-45-avg-35.onnx --
˓→joiner=./sherpa-onnx-zipformer-cantonese-2024-03-13/joiner-epoch-45-avg-35.int8.onnx ./
˓→sherpa-onnx-zipformer-cantonese-2024-03-13/test_wavs/test_wavs_1.wav ./sherpa-onnx-
˓→zipformer-cantonese-2024-03-13/test_wavs/test_wavs_2.wav

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,
˓→feature_dim=80), model_
˓→config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="./
˓→sherpa-onnx-zipformer-cantonese-2024-03-13/encoder-epoch-45-avg-35.int8.onnx", decoder_
˓→filename="./sherpa-onnx-zipformer-cantonese-2024-03-13/decoder-epoch-45-avg-35.onnx",
˓→joiner_filename="./sherpa-onnx-zipformer-cantonese-2024-03-13/joiner-epoch-45-avg-35.
˓→int8.onnx"), paraformer=OfflineParaformerModelConfig(model=""), nemo_
˓→ctc=OfflineNemoEncDecCtcModelConfig(model=""), whisper=
˓→OfflineWhisperModelConfig(encoder="", decoder="", language="", task="transcribe
˓→", tail_paddings=-1), tdnn=OfflineTdnmModelConfig(model=""), zipformer_
˓→ctc=OfflineZipformerCtcModelConfig(model=""), wenet_
˓→ctc=OfflineWenetCtcModelConfig(model=""), tokens="./sherpa-onnx-zipformer-cantonese-
˓→2024-03-13/tokens.txt", num_threads=2, debug=False, provider="cpu", model_type=""),
˓→config=OfflineLMConfig(model="", scale=0.5), ctc_fst_decoder_
˓→config=OfflineCtcFstDecoderConfig(graph="", max_active=3000), decoding_method="greedy_
˓→search", max_active_paths=4, hotwords_file="", hotwords_score=1.5, blank_penalty=1.2)
Creating recognizer ...
Started
Done!

./sherpa-onnx-zipformer-cantonese-2024-03-13/test_wavs/test_wavs_1.wav
{"text": "", "timestamps": [0.00, 0.88, 1.28, 1.52, 1.84, 2.08, 2.32, 2.56, 2.80, 3.04,
˓→3.20, 3.44, 3.68, 3.92], "tokens":["", "", "", "", "", "", "", "", "", "", "", "", ""],
˓→""]}
-----
./sherpa-onnx-zipformer-cantonese-2024-03-13/test_wavs/test_wavs_2.wav
{"text": "", "timestamps": [0.00, 0.64, 0.88, 1.12, 1.28, 1.60, 1.80, 2.16, 2.36, 2.56,
˓→2.88, 3.08, 3.32, 3.44, 3.60], "tokens":["", "", "", "", "", "", "", "", "", "", ""],
˓→", "", "", ""]}
```

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```
---
num threads: 2
decoding method: greedy_search
Elapsed seconds: 0.907 s
Real time factor (RTF): 0.907 / 10.320 = 0.088
```

## Speech recognition from a microphone

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-microphone-offline \
--tokens=./sherpa-onnx-zipformer-cantonese-2024-03-13/tokens.txt \
--encoder=./sherpa-onnx-zipformer-cantonese-2024-03-13/encoder-epoch-45-avg-35.int8 \
--onnx \
--decoder=./sherpa-onnx-zipformer-cantonese-2024-03-13/decoder-epoch-45-avg-35.onnx \
--joiner=./sherpa-onnx-zipformer-cantonese-2024-03-13/joiner-epoch-45-avg-35.int8.onnx
```

## sherpa-onnx-zipformer-gigaspeech-2023-12-12 (English)

Training code for this model is <https://github.com/k2-fsa/icefall/pull/1254>. It supports only English since it is trained on the [GigaSpeech](#) dataset.

In the following, we describe how to download it and use it with `sherpa-onnx`.

### Download the model

Please use the following commands to download it.

```
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
zipformer-gigaspeech-2023-12-12.tar.bz2

# For Chinese users, you can use the following mirror
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
zipformer-gigaspeech-2023-12-12.tar.bz2

tar xf sherpa-onnx-zipformer-gigaspeech-2023-12-12.tar.bz2
rm sherpa-onnx-zipformer-gigaspeech-2023-12-12.tar.bz2
ls -lh sherpa-onnx-zipformer-gigaspeech-2023-12-12
```

You should see the following output:

```
$ ls -lh sherpa-onnx-zipformer-gigaspeech-2023-12-12
total 656184
-rw-r--r-- 1 fangjun staff 28B Dec 12 19:00 README.md
-rw-r--r-- 1 fangjun staff 239K Dec 12 19:00 bpe.model
-rw-r--r-- 1 fangjun staff 528K Dec 12 19:00 decoder-epoch-30-avg-1.int8.onnx
-rw-r--r-- 1 fangjun staff 2.0M Dec 12 19:00 decoder-epoch-30-avg-1.onnx
-rw-r--r-- 1 fangjun staff 68M Dec 12 19:00 encoder-epoch-30-avg-1.int8.onnx
-rw-r--r-- 1 fangjun staff 249M Dec 12 19:00 encoder-epoch-30-avg-1.onnx
```

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```
-rw-r--r-- 1 fangjun staff 253K Dec 12 19:00 joiner-epoch-30-avg-1.int8.onnx
-rw-r--r-- 1 fangjun staff 1.0M Dec 12 19:00 joiner-epoch-30-avg-1.onnx
drwxr-xr-x 5 fangjun staff 160B Dec 12 19:00 test_wavs
-rw-r--r-- 1 fangjun staff 4.9K Dec 12 19:00 tokens.txt
```

## Decode wave files

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

### fp32

The following code shows how to use fp32 models to decode wave files:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./sherpa-onnx-zipformer-gigaspeech-2023-12-12/tokens.txt \
--encoder=./sherpa-onnx-zipformer-gigaspeech-2023-12-12/encoder-epoch-30-avg-1.onnx \
--decoder=./sherpa-onnx-zipformer-gigaspeech-2023-12-12/decoder-epoch-30-avg-1.onnx \
--joiner=./sherpa-onnx-zipformer-gigaspeech-2023-12-12/joiner-epoch-30-avg-1.onnx \
./sherpa-onnx-zipformer-gigaspeech-2023-12-12/test_wavs/1089-134686-0001.wav \
./sherpa-onnx-zipformer-gigaspeech-2023-12-12/test_wavs/1221-135766-0001.wav \
./sherpa-onnx-zipformer-gigaspeech-2023-12-12/test_wavs/1221-135766-0002.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./
~/build/bin/sherpa-onnx-offline --tokens=./sherpa-onnx-zipformer-gigaspeech-2023-12-12/
~/tokens.txt --encoder=./sherpa-onnx-zipformer-gigaspeech-2023-12-12/encoder-epoch-30-
~/avg-1.onnx --decoder=./sherpa-onnx-zipformer-gigaspeech-2023-12-12/decoder-epoch-30-
~/avg-1.onnx --joiner=./sherpa-onnx-zipformer-gigaspeech-2023-12-12/joiner-epoch-30-avg-
~/1.onnx ./sherpa-onnx-zipformer-gigaspeech-2023-12-12/test_wavs/1089-134686-0001.wav ./
~/sherpa-onnx-zipformer-gigaspeech-2023-12-12/test_wavs/1221-135766-0001.wav ./sherpa-
~/onnx-zipformer-gigaspeech-2023-12-12/test_wavs/1221-135766-0002.wav

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,_
~/feature_dim=80), model_
~/config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="~/
~/sherpa-onnx-zipformer-gigaspeech-2023-12-12/encoder-epoch-30-avg-1.onnx", decoder_
~/filename="~/sherpa-onnx-zipformer-gigaspeech-2023-12-12/decoder-epoch-30-avg-1.onnx",_
~/joiner_filename="~/sherpa-onnx-zipformer-gigaspeech-2023-12-12/joiner-epoch-30-avg-1.
~/onnx"), paraformer=OfflineParaformerModelConfig(model=""), nemo_
~/ctc=OfflineNemoEncDecCtcModelConfig(model=""),_
~/whisper=OfflineWhisperModelConfig(encoder="", decoder="", language="", task="transcribe
~/", tail_paddings=-1), tdnm=OfflineTdnmModelConfig(model=""), zipformer_
~/ctc=OfflineZipformerCtcModelConfig(model=""), wenet_
~/388ctc=OfflineWenetCtcModelConfig(model=""), tokens="~/sherpa-onnx-zipformer-gigaspeech-
~/2023-12-12/tokens.txt", num_threads=2, debug=False, provider="cpu", model_type=""), lm_
~/config=OfflineLmConfig(model="", scale=0.5), ctc_fst_decoder_
~/config=OfflineCtcFstDecoderConfig(graph="", max_active=3000), decoding_method="greedy_
~/search", max_active_paths=4, hotwords_file="", hotwords_score=-1.5)
```

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```
Creating recognizer ...
```

```
Started
```

```
Done!
```

```
./sherpa-onnx-zipformer-gigaspeech-2023-12-12/test_wavs/1089-134686-0001.wav
```

```
{"text": " AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE_
↪ SQUALID QUARTER OF THE BROTHELS", "timestamps": [0.00, 0.36, 0.52, 0.68, 0.96, 1.00, 1.
↪ 08, 1.28, 1.40, 1.48, 1.60, 1.76, 1.80, 1.88, 1.92, 2.00, 2.20, 2.32, 2.36, 2.48, 2.60,
↪ 2.80, 2.84, 2.92, 3.12, 3.32, 3.56, 3.76, 4.04, 4.20, 4.32, 4.40, 4.56, 4.80, 4.92, 5.
↪ 08, 5.36, 5.48, 5.64, 5.72, 5.88, 6.04, 6.24], "tokens": ["AFTER", "E", "AR", "LY", "
↪ ", "N", "IGHT", "F", "AL", "L", "THE", " ", "Y", "E", "LL", "OW", "LA", "M", "P", "S
↪ ", "WOULD", " ", "L", "IGHT", "UP", "HERE", "AND", "THERE", "THE", "S", "QU",
↪ "AL", "ID", "QU", "AR", "TER", "OF", "THE", "B", "RO", "TH", "EL", "S"]}
```

```
---
```

```
./sherpa-onnx-zipformer-gigaspeech-2023-12-12/test_wavs/1221-135766-0001.wav
```

```
{"text": " GOD AS A DIRECT CONSEQUENCE OF THE SIN WHICH MAN THUS PUNISHED HAD GIVEN HER_
↪ A LOVELY CHILD WHOSE PLACE WAS ON THAT SAME DISHONORED BOSOM TO CONNECT HER PARENT FOR_
↪ EVER WITH THE RACE AND DESCENT OF MORTALS AND TO BE FINALLY A BLESSED SOUL IN HEAVEN",
↪ "timestamps": [0.00, 0.16, 0.40, 0.68, 0.84, 0.96, 1.04, 1.12, 1.32, 1.52, 1.68, 1.76,
↪ 2.00, 2.12, 2.28, 2.40, 2.64, 2.92, 3.20, 3.32, 3.52, 3.64, 3.76, 3.96, 4.12, 4.36, 4.
↪ 52, 4.72, 4.92, 5.16, 5.40, 5.64, 5.76, 5.88, 6.12, 6.28, 6.48, 6.84, 7.08, 7.32, 7.60,
↪ 7.92, 8.12, 8.24, 8.36, 8.48, 8.64, 8.76, 8.88, 9.12, 9.32, 9.48, 9.56, 9.60, 9.76,
↪ 10.00, 10.12, 10.20, 10.44, 10.68, 10.80, 11.00, 11.20, 11.36, 11.52, 11.76, 12.00, 12.
↪ 12, 12.24, 12.28, 12.52, 12.72, 12.84, 12.96, 13.04, 13.24, 13.40, 13.64, 13.76, 14.00,
↪ 14.08, 14.24, 14.52, 14.68, 14.80, 15.00, 15.04, 15.28, 15.52, 15.76, 16.00, 16.12,
↪ 16.20, 16.32], "tokens": ["GO", "D", "AS", "A", "DI", "RE", "C", "T", "CON", "SE",
↪ "QU", "ENCE", "OF", "THE", "S", "IN", "WHICH", "MAN", "TH", "US", "P", "UN",
↪ "ISH", "ED", "HAD", "GIVE", "N", "HER", "A", "LOVE", "LY", "CHI", "L", "D", "WHO
↪ ", "SE", "PLACE", "WAS", "ON", "THAT", "SAME", "DIS", "HO", "N", "OR", "ED", "BO
↪ ", "S", "OM", "TO", "CON", "NE", "C", "T", "HER", "PA", "R", "ENT", "FOR", "E",
↪ "VER", "WITH", "THE", "RA", "CE", "AND", "DE", "S", "C", "ENT", "OF", "MO", "R",
↪ "T", "AL", "S", "AND", "TO", "BE", "F", "IN", "ALLY", "A", "B", "LES", "S", "ED
↪ ", "SO", "UL", "IN", "HE", "A", "VE", "N"]}
```

```
---
```

```
./sherpa-onnx-zipformer-gigaspeech-2023-12-12/test_wavs/1221-135766-0002.wav
```

```
{"text": " YET THESE THOUGHTS AFFECTED HESTER PRYNE LESS WITH HOPE THAN APPREHENSION",
↪ "timestamps": [0.00, 0.04, 0.12, 0.40, 0.68, 0.88, 0.96, 1.12, 1.20, 1.32, 1.44, 1.48,
↪ 1.64, 1.76, 1.88, 2.04, 2.16, 2.28, 2.52, 2.68, 2.72, 2.88, 3.12, 3.28, 3.52, 3.80, 4.
↪ 00, 4.16, 4.24, 4.40, 4.48], "tokens": ["", "Y", "ET", "THESE", "THOUGHT", "T", "S",
↪ "A", "FF", "E", "C", "TED", "HE", "S", "TER", "P", "RY", "NE", "LE", "S", "S", "WITH",
↪ "HO", "PE", "THAN", "APP", "RE", "HE", "N", "S", "ION"]}
```

```
---
```

```
num threads: 2
```

```
decoding method: greedy_search
```

```
Elapsed seconds: 1.407 s
```

```
Real time factor (RTF): 1.407 / 28.165 = 0.050
```

**int8**

The following code shows how to use int8 models to decode wave files:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./sherpa-onnx-zipformer-gigaspeech-2023-12-12/tokens.txt \
--encoder=./sherpa-onnx-zipformer-gigaspeech-2023-12-12/encoder-epoch-30-avg-1.int8.
˓→onnx \
--decoder=./sherpa-onnx-zipformer-gigaspeech-2023-12-12/decoder-epoch-30-avg-1.onnx \
--joiner=./sherpa-onnx-zipformer-gigaspeech-2023-12-12/joiner-epoch-30-avg-1.int8.onnx
˓→\
./sherpa-onnx-zipformer-gigaspeech-2023-12-12/test_wavs/1089-134686-0001.wav \
./sherpa-onnx-zipformer-gigaspeech-2023-12-12/test_wavs/1221-135766-0001.wav \
./sherpa-onnx-zipformer-gigaspeech-2023-12-12/test_wavs/1221-135766-0002.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./
˓→build/bin/sherpa-onnx-offline --tokens=./sherpa-onnx-zipformer-gigaspeech-2023-12-12/
˓→tokens.txt --encoder=./sherpa-onnx-zipformer-gigaspeech-2023-12-12/encoder-epoch-30-
˓→avg-1.int8.onnx --decoder=./sherpa-onnx-zipformer-gigaspeech-2023-12-12/decoder-epoch-
˓→30-avg-1.onnx --joiner=./sherpa-onnx-zipformer-gigaspeech-2023-12-12/joiner-epoch-30-
˓→avg-1.int8.onnx ./sherpa-onnx-zipformer-gigaspeech-2023-12-12/test_wavs/1089-134686-
˓→0001.wav ./sherpa-onnx-zipformer-gigaspeech-2023-12-12/test_wavs/1221-135766-0001.wav .
˓→/sherpa-onnx-zipformer-gigaspeech-2023-12-12/test_wavs/1221-135766-0002.wav

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,
˓→feature_dim=80), model_
˓→config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="./
˓→sherpa-onnx-zipformer-gigaspeech-2023-12-12/encoder-epoch-30-avg-1.int8.onnx", decoder_
˓→filename="./sherpa-onnx-zipformer-gigaspeech-2023-12-12/decoder-epoch-30-avg-1.onnx",
˓→joiner_filename="./sherpa-onnx-zipformer-gigaspeech-2023-12-12/joiner-epoch-30-avg-1.
˓→int8.onnx"), paraformer=OfflineParaformerModelConfig(model=""), nemo_
˓→ctc=OfflineNemoEncDecCtcModelConfig(model=""), whisper=OfflineWhisperModelConfig(encoder="",
˓→decoder="", language="", task="transcribe", tail_paddings=-1), tdnn=OfflineTdnModelConfig(model=""),
˓→zipformer_ctc=OfflineZipformerCtcModelConfig(model=""), wenet_
˓→ctc=OfflineWenetCtcModelConfig(model=""), tokens="./sherpa-onnx-zipformer-gigaspeech-
˓→2023-12-12/tokens.txt", num_threads=2, debug=False, provider="cpu", model_type=""),
˓→lm_config=OfflineLMConfig(model="", scale=0.5), ctc fst_decoder_
˓→config=OfflineCtcFstDecoderConfig(graph="", max_active=3000), decoding_method="greedy_
˓→search", max_active_paths=4, hotwords_file="", hotwords_score=1.5)
Creating recognizer ...
Started
Done!

./sherpa-onnx-zipformer-gigaspeech-2023-12-12/test_wavs/1089-134686-0001.wav
{"text": " AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE
˓→SQUALID QUARTER OF THE BROTHELS", "timestamps": [0.00, 0.36, 0.52, 0.68, (0.96 bytes in 0.01 page)
˓→08, 1.28, 1.40, 1.48, 1.60, 1.76, 1.80, 1.88, 1.92, 2.00, 2.20, 2.32, 2.36, 2.48, 2.60,
˓→2.80, 2.84, 2.92, 3.12, 3.32, 3.56, 3.76, 4.04, 4.24, 4.32, 4.40, 4.56, 4.80, 4.92, 5.
˓→3908, 5.36, 5.48, 5.64, 5.72, 5.88, 6.04, 6.24], "tokens": ["AFTER", "E", "AR", "LY",
˓→", "N", "IGHT", "F", "AL", "L", "THE", " ", "Y", "E", "LL", "OW", "LA", "M", "P", "S",
˓→", "WOULD", " ", "L", "IGHT", "UP", "HERE", "AND", "THERE", "THE", "S", "QU",
˓→"AL", "ID", "QU", "AR", "TER", "OF", "THE", "B", "RO", "TH", "EL", "S"]}
```

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```
-----
./sherpa-onnx-zipformer-gigaspeech-2023-12-12/test_wavs/1221-135766-0001.wav
{"text": " GOD AS A DIRECT CONSEQUENCE OF THE SIN WHICH MAN THUS PUNISHED HAD GIVEN HER.  

↳ A LOVELY CHILD WHOSE PLACE WAS ON THAT SAME DISHONORED BOSOM TO CONNECT HER PARENT FOR.  

↳ EVER WITH THE RACE AND DESCENT OF MORTALS AND TO BE FINALLY A BLESSED SOUL IN HEAVEN",  

↳ "timestamps": [0.00, 0.16, 0.40, 0.68, 0.84, 0.96, 1.08, 1.12, 1.32, 1.52, 1.68, 1.76,  

↳ 2.00, 2.12, 2.28, 2.40, 2.64, 2.92, 3.20, 3.32, 3.52, 3.64, 3.76, 3.96, 4.12, 4.36, 4.  

↳ 52, 4.72, 4.92, 5.16, 5.40, 5.64, 5.76, 5.88, 6.12, 6.28, 6.52, 6.84, 7.08, 7.32, 7.60,  

↳ 7.92, 8.12, 8.24, 8.36, 8.48, 8.64, 8.76, 8.88, 9.12, 9.32, 9.48, 9.56, 9.60, 9.76,  

↳ 10.00, 10.12, 10.20, 10.44, 10.68, 10.80, 11.00, 11.20, 11.36, 11.52, 11.76, 12.00, 12.  

↳ 12, 12.24, 12.28, 12.52, 12.72, 12.84, 12.96, 13.04, 13.24, 13.44, 13.64, 13.76, 14.00,  

↳ 14.08, 14.24, 14.52, 14.68, 14.80, 15.00, 15.04, 15.28, 15.48, 15.76, 16.00, 16.12,  

↳ 16.16, 16.32], "tokens": [" GO", "D", " AS", " A", " DI", "RE", "C", "T", " CON", "SE",  

↳ "QU", "ENCE", " OF", " THE", " S", "IN", " WHICH", " MAN", " TH", "US", " P", "UN",  

↳ "ISH", "ED", " HAD", " GIVE", "N", " HER", " A", " LOVE", "LY", " CHI", "L", "D", " WHO  

↳ ", "SE", " PLACE", " WAS", " ON", " THAT", " SAME", " DIS", "HO", "N", "OR", "ED", " BO  

↳ ", "S", "OM", " TO", " CON", "NE", "C", "T", " HER", " PA", "R", "ENT", " FOR", " E",  

↳ "VER", " WITH", " THE", " RA", "CE", " AND", " DE", "S", "C", "ENT", " OF", " MO", "R",  

↳ "T", "AL", "S", " AND", " TO", " BE", " F", "IN", "ALLY", " A", " B", "LES", "S", "ED  

↳ ", " SO", "UL", " IN", " HE", "A", "VE", "N"]}
```

```
-----
./sherpa-onnx-zipformer-gigaspeech-2023-12-12/test_wavs/1221-135766-0002.wav
{"text": " YET THESE THOUGHTS AFFECTED HESTER PRYNNE LESS WITH HOPE THAN APPREHENSION",  

↳ "timestamps": [0.00, 0.04, 0.12, 0.40, 0.68, 0.88, 0.96, 1.12, 1.24, 1.32, 1.44, 1.48,  

↳ 1.64, 1.76, 1.88, 2.04, 2.16, 2.28, 2.32, 2.52, 2.68, 2.72, 2.88, 3.12, 3.32, 3.52, 3.  

↳ 80, 4.00, 4.16, 4.24, 4.40, 4.48], "tokens": [" ", "Y", "ET", " THESE", " THOUGH", "T",  

↳ "S", " A", "FF", "E", "C", "TED", " HE", "S", "TER", " P", "RY", "N", "NE", " LE", "S",  

↳ "S", " WITH", " HO", "PE", " THAN", " APP", "RE", "HE", "N", "S", "ION"]}
```

```
-----
num threads: 2
decoding method: greedy_search
Elapsed seconds: 1.101 s
Real time factor (RTF): 1.101 / 28.165 = 0.039
```

## Speech recognition from a microphone

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-microphone-offline \
--tokens=./sherpa-onnx-zipformer-gigaspeech-2023-12-12/tokens.txt \
--encoder=./sherpa-onnx-zipformer-gigaspeech-2023-12-12/encoder-epoch-30-avg-1.int8.
--onnx \
--decoder=./sherpa-onnx-zipformer-gigaspeech-2023-12-12/decoder-epoch-30-avg-1.onnx \
--joiner=./sherpa-onnx-zipformer-gigaspeech-2023-12-12/joiner-epoch-30-avg-1.int8.onnx
```

## Speech recognition from a microphone with VAD

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/silero_vad.onnx

# For Chinese users, you can use the following mirror
# wget https://hub.nuua.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/silero_vad.
→ onnx

./build/bin/sherpa-onnx-vad-microphone-offline-asr \
--silero-vad-model=./silero_vad.onnx \
--tokens=./sherpa-onnx-zipformer-gigaspeech-2023-12-12/tokens.txt \
--encoder=./sherpa-onnx-zipformer-gigaspeech-2023-12-12/encoder-epoch-30-avg-1.int8.
→ onnx \
--decoder=./sherpa-onnx-zipformer-gigaspeech-2023-12-12/decoder-epoch-30-avg-1.onnx \
--joiner=./sherpa-onnx-zipformer-gigaspeech-2023-12-12/joiner-epoch-30-avg-1.int8.onnx
```

### [zrjin/sherpa-onnx-zipformer-multi-zh-hans-2023-9-2 \(Chinese\)](#)

This model is from

<https://huggingface.co/zrjin/sherpa-onnx-zipformer-multi-zh-hans-2023-9-2>

which supports Chinese as it is trained on whatever datasets involved in the `multi-zh_hans` recipe.

If you are interested in how the model is trained, please refer to <https://github.com/k2-fsa/icefall/pull/1238>.

In the following, we describe how to download it and use it with `sherpa-onnx`.

## Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
→ zipformer-multi-zh-hans-2023-9-2.tar.bz2

# For Chinese users, you can use the following mirror
# wget https://hub.nuua.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
→ zipformer-multi-zh-hans-2023-9-2.tar.bz2

tar xvf sherpa-onnx-zipformer-multi-zh-hans-2023-9-2.tar.bz2
rm sherpa-onnx-zipformer-multi-zh-hans-2023-9-2.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of `*.onnx` files below.

```
sherpa-onnx-zipformer-multi-zh-hans-2023-9-2 zengruijin$ ls -lh *.onnx
-rw-rw-r--@ 1 zengruijin staff 1.2M Sep 18 07:04 decoder-epoch-20-avg-1.int8.onnx
-rw-rw-r--@ 1 zengruijin staff 4.9M Sep 18 07:04 decoder-epoch-20-avg-1.onnx
-rw-rw-r--@ 1 zengruijin staff 66M Sep 18 07:04 encoder-epoch-20-avg-1.int8.onnx
```

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```
-rw-rw-r--@ 1 zengruijin  staff  248M Sep 18 07:05 encoder-epoch-20-avg-1.onnx
-rw-rw-r--@ 1 zengruijin  staff  1.0M Sep 18 07:05 joiner-epoch-20-avg-1.int8.onnx
-rw-rw-r--@ 1 zengruijin  staff  3.9M Sep 18 07:05 joiner-epoch-20-avg-1.onnx
```

## Decode wave files

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

### fp32

The following code shows how to use fp32 models to decode wave files:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./sherpa-onnx-zipformer-multi-zh-hans-2023-9-2/tokens.txt \
--encoder=./sherpa-onnx-zipformer-multi-zh-hans-2023-9-2/encoder-epoch-20-avg-1.onnx \
--decoder=./sherpa-onnx-zipformer-multi-zh-hans-2023-9-2/decoder-epoch-20-avg-1.onnx \
--joiner=./sherpa-onnx-zipformer-multi-zh-hans-2023-9-2/joiner-epoch-20-avg-1.onnx \
./sherpa-onnx-zipformer-multi-zh-hans-2023-9-2/test_wavs/0.wav \
./sherpa-onnx-zipformer-multi-zh-hans-2023-9-2/test_wavs/1.wav \
./sherpa-onnx-zipformer-multi-zh-hans-2023-9-2/test_wavs/8k.wav
```

**Note:** Please use ./build/bin/Release/sherpa-onnx-offline.exe for Windows.

You should see the following output:

```
/Users/runner/work/sherpa-onnx/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361
sherpa-onnx-offline --tokens=./sherpa-onnx-zipformer-multi-zh-hans-2023-9-2/tokens.txt --
--encoder=./sherpa-onnx-zipformer-multi-zh-hans-2023-9-2/encoder-epoch-20-avg-1.onnx --
--decoder=./sherpa-onnx-zipformer-multi-zh-hans-2023-9-2/decoder-epoch-20-avg-1.onnx --
--joiner=./sherpa-onnx-zipformer-multi-zh-hans-2023-9-2/joiner-epoch-20-avg-1.onnx ./
sherpa-onnx-zipformer-multi-zh-hans-2023-9-2/test_wavs/0.wav ./sherpa-onnx-zipformer-
multi-zh-hans-2023-9-2/test_wavs/1.wav ./sherpa-onnx-zipformer-multi-zh-hans-2023-9-2/
test_wavs/8k.wav

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,_
feature_dim=80), model_
config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="./
sherpa-onnx-zipformer-multi-zh-hans-2023-9-2/encoder-epoch-20-avg-1.onnx", decoder_
filename="./sherpa-onnx-zipformer-multi-zh-hans-2023-9-2/decoder-epoch-20-avg-1.onnx",_
joiner_filename="./sherpa-onnx-zipformer-multi-zh-hans-2023-9-2/joiner-epoch-20-avg-1.
onnx"), paraformer=OfflineParaformerModelConfig(model=""), nemo_
ctc=OfflineNemoEncDecCtcModelConfig(model=""),_
whisper=OfflineWhisperModelConfig(encoder="", decoder="", language="", task="transcribe
"), tdnn=OfflineTdnmModelConfig(model=""), tokens="./sherpa-onnx-zipformer-multi-zh-
hans-2023-9-2/tokens.txt", num_threads=2, debug=False, provider="cpu", model_type="",
lm_config=OfflineLMConfig(model="", scale=0.5), decoding_method="greedy_search", max_
active_paths=4, hotwords_file="", hotwords_score=1.5)
```

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```

Creating recognizer ...
Started
/Users/runner/work/sherpa-onnx/sherpa-onnx/sherpa-onnx/csrc/offline-stream.
↳ cc:AcceptWaveformImpl:117 Creating a resampler:
  in_sample_rate: 8000
  output_sample_rate: 16000

Done!

./sherpa-onnx-zipformer-multi-zh-hans-2023-9-2/test_wavs/0.wav
{"text": " ", "timestamps": "[0.00, 0.16, 0.40, 0.60, 0.84, 1.08, 1.60, 1.72, 1.88, 2.04, 2.
↳ 24, 2.44, 2.60, 2.96, 3.12, 3.32, 3.40, 3.60, 3.72, 3.84, 4.00, 4.16, 4.32, 4.52, 4.68]
↳ , "tokens": [" ", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "
↳ "]} ----
./sherpa-onnx-zipformer-multi-zh-hans-2023-9-2/test_wavs/1.wav
{"text": "<0xE8><0x8D><0xA1>", "timestamps": "[0.00, 0.12, 0.48, 0.68, 0.92, 1.12, 1.28, 1.
↳ 48, 1.80, 2.04, 2.40, 2.56, 2.76, 2.96, 3.08, 3.32, 3.48, 3.68, 3.84, 4.00, 4.20, 4.24,
↳ 4.28, 4.40, 4.60, 4.84]", "tokens": [" ", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "
↳ ", "", "", "", "<0xE8>", "<0x8D>", "<0xA1>", "", "", ""]} ----
./sherpa-onnx-zipformer-multi-zh-hans-2023-9-2/test_wavs/8k.wav
{"text": "<0xE8><0x8D><0xA1>", "timestamps": "[0.00, 0.04, 0.24, 0.52, 0.76, 1.00, 1.40, 1.
↳ 64, 1.80, 2.12, 2.32, 2.64, 2.80, 3.00, 3.20, 3.24, 3.28, 3.44, 3.64, 3.76, 3.96, 4.20]
↳ , "tokens": [" ", "", "", "", "", "", "", "", "", "", "<0xE8>", "<0x8D>", "<0xA1>", "", "
↳ ", "", "", ""]} ----
num threads: 2
decoding method: greedy_search
Elapsed seconds: 0.362 s
Real time factor (RTF): 0.362 / 15.289 = 0.024

```

**int8**

The following code shows how to use int8 models to decode wave files:

```

cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
  --tokens=./sherpa-onnx-zipformer-multi-zh-hans-2023-9-2/tokens.txt \
  --encoder=./sherpa-onnx-zipformer-multi-zh-hans-2023-9-2/encoder-epoch-20-avg-1.int8.
  ↳ onnx \
  --decoder=./sherpa-onnx-zipformer-multi-zh-hans-2023-9-2/decoder-epoch-20-avg-1.onnx \
  --joiner=./sherpa-onnx-zipformer-multi-zh-hans-2023-9-2/joiner-epoch-20-avg-1.int8.
  ↳ onnx \
  ./sherpa-onnx-zipformer-multi-zh-hans-2023-9-2/test_wavs/0.wav \
  ./sherpa-onnx-zipformer-multi-zh-hans-2023-9-2/test_wavs/1.wav \
  ./sherpa-onnx-zipformer-multi-zh-hans-2023-9-2/test_wavs/8k.wav

```

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

You should see the following output:

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```
----  
num threads: 2  
decoding method: greedy_search  
Elapsed seconds: 0.305 s  
Real time factor (RTF): 0.305 / 15.289 = 0.020
```

## Speech recognition from a microphone

```
cd /path/to/sherpa-onnx  
  
.build/bin/sherpa-onnx-microphone-offline \  
  --tokens=./sherpa-onnx-zipformer-multi-zh-hans-2023-9-2/tokens.txt \  
  --encoder=./sherpa-onnx-zipformer-multi-zh-hans-2023-9-2/encoder-epoch-20-avg-1.onnx \  
  --decoder=./sherpa-onnx-zipformer-multi-zh-hans-2023-9-2/decoder-epoch-0-avg-1.onnx \  
  --joiner=./sherpa-onnx-zipformer-multi-zh-hans-2023-9-2/joiner-epoch-20-avg-1.onnx
```

[yfyeung/icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-04-17](https://huggingface.co/yfyeung/icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-04-17) (English)

This model is from

<https://huggingface.co/yfyeung/icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-04-17>

which supports only English as it is trained on the [CommonVoice](#) English dataset.

If you are interested in how the model is trained, please refer to <https://github.com/k2-fsa/icefall/pull/997>.

In the following, we describe how to download it and use it with [sherpa-onnx](#).

## Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx  
  
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/icefall-asr-cv-  
  ↪corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-04-17.tar.bz2  
  
# For Chinese users, you can use the following mirror  
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/icefall-asr-  
  ↪cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-04-17.tar.bz2  
  
tar xvf icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-04-17.  
  ↪tar.bz2  
rm icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-04-17.tar.  
  ↪bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of \*.onnx files below.

```
icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-04-17 fangjun
$ ls -lh exp/*epoch-60-avg-20*.onnx
-rw-r--r-- 1 fangjun staff 1.2M Jun 27 09:53 exp/decoder-epoch-60-avg-20.int8.onnx
-rw-r--r-- 1 fangjun staff 2.0M Jun 27 09:54 exp/decoder-epoch-60-avg-20.onnx
-rw-r--r-- 1 fangjun staff 121M Jun 27 09:54 exp/encoder-epoch-60-avg-20.int8.onnx
-rw-r--r-- 1 fangjun staff 279M Jun 27 09:55 exp/encoder-epoch-60-avg-20.onnx
-rw-r--r-- 1 fangjun staff 253K Jun 27 09:53 exp/joiner-epoch-60-avg-20.int8.onnx
-rw-r--r-- 1 fangjun staff 1.0M Jun 27 09:53 exp/joiner-epoch-60-avg-20.onnx
```

## Decode wave files

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

### fp32

The following code shows how to use fp32 models to decode wave files:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-
$ 04-17/data/lang_bpe_500/tokens.txt \
--encoder=./icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-
$ 04-17/exp/encoder-epoch-60-avg-20.onnx \
--decoder=./icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-
$ 04-17/exp/decoder-epoch-60-avg-20.onnx \
--joiner=./icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-
$ 04-17/exp/joiner-epoch-60-avg-20.onnx \
./icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-04-17/
$ test_wavs/1089-134686-0001.wav \
./icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-04-17/
$ test_wavs/1221-135766-0001.wav \
./icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-04-17/
$ test_wavs/1221-135766-0002.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./
$ build/bin/sherpa-onnx-offline --tokens=./icefall-asr-cv-corpus-13.0-2023-03-09-en-
$ pruned-transducer-stateless7-2023-04-17/data/lang_bpe_500/tokens.txt --encoder=./
$ icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-04-17/exp/
$ encoder-epoch-60-avg-20.onnx --decoder=./icefall-asr-cv-corpus-13.0-2023-03-09-en-
$ pruned-transducer-stateless7-2023-04-17/exp/decoder-epoch-60-avg-20.onnx --joiner=./
$ icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-04-17/exp/
$ joiner-epoch-60-avg-20.onnx ./icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-
$ transducer-stateless7-2023-04-17/test_wavs/1089-134686-0001.wav ./icefall-asr-cv-
$ corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-04-17/test_wavs/1221-
$ 0001.wav ./icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-
$ stateless7-2023-04-17/test_wavs/1221-135766-0002.wav
```

```

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,
    ↵ feature_dim=80), model_
    ↵ config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="./
    ↵ icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-04-17/exp/
    ↵ encoder-epoch-60-avg-20.ckpt", decoder_filename="./icefall-asr-cv-corpus-13.0-2023-03-
    ↵ 09-en-pruned-transducer-stateless7-2023-04-17/exp/decoder-epoch-60-avg-20.ckpt", ↵
    ↵ joiner_filename="./icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-
    ↵ stateless7-2023-04-17/exp/joiner-epoch-60-avg-20.ckpt"), ↵
    ↵ paraformer=OfflineParaformerModelConfig(model=""), nemo_
    ↵ ctc=OfflineNemoEncDecCtcModelConfig(model=""), tokens="./icefall-asr-cv-corpus-13.0-
    ↵ 2023-03-09-en-pruned-transducer-stateless7-2023-04-17/data/lang_bpe_500/tokens.txt", ↵
    ↵ num_threads=2, debug=False, provider="cpu"), lm_config=OfflineLMConfig(model="", ↵
    ↵ scale=0.5), decoding_method="greedy_search", max_active_paths=4, context_score=1.5)
Creating recognizer ...
Started
Done!

./icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-04-17/test_
    ↵ wavs/1089-134686-0001.wav
{"text":" AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE_
    ↵ SQUALID QUARTER OF THE BROTHELS", "timestamps": "[0.00, 0.64, 0.76, 0.84, 1.04, 1.08, 1.
    ↵ 16, 1.32, 1.44, 1.56, 1.72, 1.84, 1.88, 1.92, 1.96, 2.04, 2.16, 2.32, 2.48, 2.56, 2.76,
    ↵ 2.80, 2.84, 3.08, 3.28, 3.40, 3.52, 3.68, 4.00, 4.24, 4.28, 4.52, 4.68, 4.84, 4.88, 4.
    ↵ 96, 5.04, 5.28, 5.40, 5.52, 5.72, 5.88, 6.08]", "tokens": [" AFTER", " E", "AR", "LY", " ", "N
    ↵ ", "IGHT", "F", "AL", "L", " THE", " ", "Y", "E", "LL", "OW", " LA", "MP", "S", " WOULD", " ", "L",
    ↵ "IGHT", " UP", " HE", "RE", " AND", " THERE", " THE", " S", "QUA", "LI", "D", " ", "QUA", "R", "TER",
    ↵ " OF", " THE", " BRO", "TH", "EL", "S"]}

----
```

```

./icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-04-17/test_
    ↵ wavs/1221-135766-0001.wav
{"text":" GOD AS A DIRECT CONSEQUENCE OF THE SIN WHICH MAN THUS PUNISHED HAD GIVEN HER A_
    ↵ LOVELY CHILD WHOSE PLACE WAS ON THAT SAME DISHONORED BOSOM TO CONNECT HER PARENT_
    ↵ FOREVER WITH THE RACE AND DESCENT OF MORTALS AND TO BE FINALLY A BLESSED SOUL IN HEAVEN
    ↵ ", "timestamps": "[0.04, 0.44, 0.64, 0.84, 0.96, 1.32, 1.52, 1.68, 1.84, 1.88, 2.04, 2.
    ↵ 16, 2.32, 2.40, 2.64, 2.88, 3.12, 3.24, 3.44, 3.52, 3.72, 3.88, 4.20, 4.40, 4.48, 4.60,
    ↵ 4.76, 4.96, 5.08, 5.24, 5.36, 5.56, 5.80, 6.20, 6.32, 6.52, 6.92, 7.16, 7.36, 7.60, 7.
    ↵ 76, 7.92, 8.16, 8.28, 8.40, 8.48, 8.60, 8.76, 8.84, 9.08, 9.24, 9.44, 9.48, 9.72, 9.88,
    ↵ 10.04, 10.12, 10.52, 10.76, 10.84, 11.08, 11.24, 11.36, 11.60, 11.76, 11.96, 12.08,
    ↵ 12.24, 12.28, 12.48, 12.72, 12.84, 12.92, 13.00, 13.20, 13.52, 13.76, 13.88, 14.08, 14.
    ↵ 28, 14.52, 14.64, 14.76, 14.96, 15.04, 15.24, 15.48, 15.68, 15.84, 16.00, 16.04]", "tokens": [
    ↵ " GO", "D", " AS", " A", " DIRECT", " CON", "SE", "QUE", "N", "CE", " OF", " THE", " S",
    ↵ "IN", " WHICH", " MAN", " TH", "US", " P", "UN", "ISH", "ED", " HAD", " G", "IVE", "N", " HER", " A",
    ↵ " LO", "VE", "LY", " CHI", "LD", " WHO", "SE", " PLACE", " WAS", " ON", " THAT", " SA", "ME", " DIS
    ↵ " , "HO", "N", "OR", "ED", " BO", "S", "OM", " TO", " CON", "N", "ECT", " HER", " PA", "R", "ENT", " FOR
    ↵ " , "E", "VER", " WITH", " THE", " RA", "CE", " AND", " DE", "S", "C", "ENT", " OF", " MO", "R", "T",
    ↵ "AL", "S", " AND", " TO", " BE", " FIN", "ALLY", " A", " B", "LES", "S", "ED", " SO", "UL", " IN", " HE",
    ↵ "A", "VEN"]}

----
```

```

./icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-04-17/test_
    ↵ wavs/1221-135766-0002.wav
{"text":" YET THESE THOUGHTS AFFECTED HESTER PRIN LESS WITH HOPE THAN APPREHENSION",
    ↵ "timestamps": "[0.00, 0.04, 0.12, 0.56, 0.80, 0.88, 1.00, 1.04, 1.12, 1.20, 1.28, 1.40] (continued on next page)
    ↵ 1.52, 1.64, 1.76, 1.84, 2.04, 2.24, 2.40, 2.64, 2.68, 2.84, 3.04, 3.24, 3.44, 3.52, 3.
    ↵ 72, 3.92, 4.00, 4.16, 4.24, 4.36]", "tokens": [" ", "Y", "ET", " THESE", " TH", "O", "UGH", "T",
    ↵ 398, " S", " A", "FF", "ECT", "ED", " HE", "S", "TER", " PRI", "N", " LE", "S", "S", "WITH", "HO", "PE", " Chapter 8: sherpa onnx
    ↵ "TH", "AN", " APP", "RE", "HE", "N", "S", "ION"]}
```

(continued from previous page)

```
-----
num threads: 2
decoding method: greedy_search
Elapsed seconds: 1.611 s
Real time factor (RTF): 1.611 / 28.165 = 0.057
```

## int8

The following code shows how to use int8 models to decode wave files:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-
˓→04-17/data/lang_bpe_500/tokens.txt \
--encoder=./icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-
˓→04-17/exp/encoder-epoch-60-avg-20.int8.onnx \
--decoder=./icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-
˓→04-17/exp/decoder-epoch-60-avg-20.onnx \
--joiner=./icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-
˓→04-17/exp/joiner-epoch-60-avg-20.int8.onnx \
./icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-04-17/
˓→test_wavs/1089-134686-0001.wav \
./icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-04-17/
˓→test_wavs/1221-135766-0001.wav \
./icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-04-17/
˓→test_wavs/1221-135766-0002.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./
˓→build/bin/sherpa-onnx-offline --tokens=./icefall-asr-cv-corpus-13.0-2023-03-09-en-
˓→pruned-transducer-stateless7-2023-04-17/data/lang_bpe_500/tokens.txt --encoder=./
˓→icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-04-17/exp/
˓→encoder-epoch-60-avg-20.int8.onnx --decoder=./icefall-asr-cv-corpus-13.0-2023-03-09-en-
˓→pruned-transducer-stateless7-2023-04-17/exp/decoder-epoch-60-avg-20.onnx --joiner=./
˓→icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-04-17/exp/
˓→joiner-epoch-60-avg-20.int8.onnx ./icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-
˓→transducer-stateless7-2023-04-17/test_wavs/1089-134686-0001.wav ./icefall-asr-cv-
˓→corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-04-17/test_wavs/1221-
˓→135766-0001.wav ./icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-
˓→stateless7-2023-04-17/test_wavs/1221-135766-0002.wav

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,
˓→feature_dim=80), model_
˓→config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="./
˓→icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-04-17/exp/
˓→encoder-epoch-60-avg-20.int8.onnx", decoder_filename="./icefall-asr-cv-corpus-13.0-
˓→2023-03-09-en-pruned-transducer-stateless7-2023-04-17/exp/decoder-epoch-60-avg-20.onnx"
˓→", joiner_filename="./icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-
˓→stateless7-2023-04-17/exp/joiner-epoch-60-avg-20.int8.onnx"),
```

(continued from previous page)

```

Creating recognizer ...
Started
Done!

./icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-04-17/test_
↳ wavs/1089-134686-0001.wav
{"text":" AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE_
↳ SQUALID QUARTER OF THE BROTHELS","timestamps":[0.00, 0.64, 0.76, 0.84, 1.04, 1.08, 1.
↳ 16, 1.36, 1.44, 1.56, 1.72, 1.84, 1.88, 1.92, 1.96, 2.04, 2.20, 2.32, 2.48, 2.56, 2.76,
↳ 2.80, 2.84, 3.08, 3.28, 3.40, 3.52, 3.68, 4.00, 4.24, 4.28, 4.52, 4.68, 4.84, 4.88, 4.
↳ 96, 5.04, 5.28, 5.36, 5.52, 5.72, 5.88, 6.08],"tokens":[" AFTER", " E", "AR", "LY", " ", "N
↳ ", "IGHT", "F", "AL", "L", " THE", " ", "Y", "E", "LL", "OW", " LA", "MP", "S", " WOULD", " ", "L",
↳ "IGHT", " UP", " HE", "RE", " AND", " THERE", " THE", " S", "QUA", "LI", "D", " ", "QUA", "R", "TER",
↳ " OF", " THE", " BRO", "TH", "EL", "S"]}

-----
./icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-04-17/test_
↳ wavs/1221-135766-0001.wav
{"text":" GOD AS A DIRECT CONSEQUENCE OF THE SIN WHICH MAN THUS PUNISHED HAD GIVEN HER A_
↳ LOVELY CHILD WHOSE PLACE WAS ON THAT SAME DISHONORED BOSOM TO CONNECT HER PARENT_
↳ FOREVER WITH THE RACE AND DESCENT OF MORTALS AND TO BE FINALLY A BLESSED SOUL IN HEAVEN
↳ ","timestamps":[0.04, 0.44, 0.64, 0.84, 0.96, 1.32, 1.52, 1.68, 1.84, 1.88, 2.04, 2.
↳ 16, 2.32, 2.40, 2.64, 2.88, 3.12, 3.24, 3.44, 3.52, 3.72, 3.88, 4.20, 4.40, 4.48, 4.60,
↳ 4.76, 4.96, 5.08, 5.24, 5.36, 5.56, 5.80, 6.20, 6.32, 6.52, 6.92, 7.16, 7.32, 7.60, 7.
↳ 76, 7.92, 8.16, 8.28, 8.40, 8.48, 8.60, 8.76, 8.84, 9.08, 9.24, 9.44, 9.48, 9.72, 9.88,
↳ 10.04, 10.12, 10.52, 10.76, 10.84, 11.08, 11.24, 11.36, 11.60, 11.76, 11.96, 12.08, 12.
↳ 24, 12.28, 12.48, 12.72, 12.84, 12.92, 13.00, 13.20, 13.52, 13.76, 13.88, 14.08, 14.
↳ 28, 14.52, 14.64, 14.76, 14.96, 15.04, 15.24, 15.48, 15.68, 15.84, 16.00, 16.04],"tokens":[" GO", "D", " AS", " A", " DIRECT", " CON", "SE", "QUE", "N", "CE", " OF", " THE", " S",
↳ "IN", " WHICH", " MAN", " TH", "US", " P", "UN", "ISH", "ED", " HAD", " G", "IVE", "N", " HER", " A",
↳ " LO", "VE", "LY", " CHI", "LD", " WHO", "SE", " PLACE", " WAS", " ON", " THAT", " SA", "ME", " DIS
↳ ", "HO", "N", "OR", "ED", " BO", "S", "OM", " TO", " CON", "N", "ECT", " HER", " PA", "R", "ENT", " FOR
↳ ", "E", "VER", " WITH", " THE", " RA", "CE", " AND", " DE", "S", "C", "ENT", " OF", " MO", "R", "T",
↳ "AL", "S", " AND", " TO", " BE", " FIN", "ALLY", " A", " B", "LES", "S", "ED", " SO", "UL", " IN", " HE",
↳ "A", "VEN"]}

-----
./icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-04-17/test_
↳ wavs/1221-135766-0002.wav
{"text":" YET THESE THOUGHTS AFFECTED HESTER PRIN LESS WITH HOPE THAN APPREHENSION",
↳ "timestamps":[0.00, 0.04, 0.12, 0.56, 0.80, 0.88, 1.00, 1.04, 1.12, 1.20, 1.28, 1.40,
↳ 1.52, 1.64, 1.76, 1.84, 2.04, 2.24, 2.40, 2.64, 2.68, 2.84, 3.04, 3.24, 3.44, 3.52, 3.
↳ 72, 3.92, 4.00, 4.16, 4.24, 4.36],"tokens":[" ", "Y", "ET", " THESE", " TH", "O", "UGH", "T",
↳ "S", " A", "FF", "ECT", "ED", " HE", "S", "TER", " PRI", "N", " LE", "S", "S", " WITH", " HO", "PE",
↳ "TH", "AN", " APP", "RE", "HE", "N", "S", "ION"]}

-----
num threads: 2
decoding method: greedy_search
Elapsed seconds: 1.368 s
Real time factor (RTF): 1.368 / 28.165 = 0.049

```

## Speech recognition from a microphone

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-microphone-offline \
--tokens=./icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-
˓→04-17/data/lang_bpe_500/tokens.txt \
--encoder=./icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-
˓→04-17/exp/encoder-epoch-60-avg-20.onnx \
--decoder=./icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-
˓→04-17/exp/decoder-epoch-60-avg-20.onnx \
--joiner=./icefall-asr-cv-corpus-13.0-2023-03-09-en-pruned-transducer-stateless7-2023-
˓→04-17/exp/joiner-epoch-60-avg-20.onnx
```

## pkufool/icefall-asr-zipformer-wenetspeech-20230615 (Chinese)

This model is from

<https://huggingface.co/pkufool/icefall-asr-zipformer-wenetspeech-20230615>

which supports only Chinese as it is trained on the [WenetSpeech](#) corpus.

If you are interested in how the model is trained, please refer to <https://github.com/k2-fsa/icefall/pull/1130>.

In the following, we describe how to download it and use it with `sherpa-onnx`.

### Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/icefall-asr-
˓→zipformer-wenetspeech-20230615.tar.bz2

# For Chinese users, you can use the following mirror
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/icefall-asr-
˓→zipformer-wenetspeech-20230615.tar.bz2

tar xvf icefall-asr-zipformer-wenetspeech-20230615.tar.bz2
rm icefall-asr-zipformer-wenetspeech-20230615.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of `*.onnx` files below.

```
icefall-asr-zipformer-wenetspeech-20230615 fangjun$ ls -lh exp/*.onnx
-rw-r--r-- 1 fangjun staff 11M Jun 26 14:31 exp/decoder-epoch-12-avg-4.int8.onnx
-rw-r--r-- 1 fangjun staff 12M Jun 26 14:31 exp/decoder-epoch-12-avg-4.onnx
-rw-r--r-- 1 fangjun staff 66M Jun 26 14:32 exp/encoder-epoch-12-avg-4.int8.onnx
-rw-r--r-- 1 fangjun staff 248M Jun 26 14:34 exp/encoder-epoch-12-avg-4.onnx
-rw-r--r-- 1 fangjun staff 2.7M Jun 26 14:31 exp/joiner-epoch-12-avg-4.int8.onnx
-rw-r--r-- 1 fangjun staff 11M Jun 26 14:31 exp/joiner-epoch-12-avg-4.onnx
```

## Decode wave files

---

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

---

### fp32

The following code shows how to use fp32 models to decode wave files:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./icefall-asr-zipformer-wenetspeech-20230615/data/lang_char/tokens.txt \
--encoder=./icefall-asr-zipformer-wenetspeech-20230615/exp/encoder-epoch-12-avg-4.onnx \
--decoder=./icefall-asr-zipformer-wenetspeech-20230615/exp/decoder-epoch-12-avg-4.onnx \
--joiner=./icefall-asr-zipformer-wenetspeech-20230615/exp/joiner-epoch-12-avg-4.onnx \
./icefall-asr-zipformer-wenetspeech-20230615/test_wavs/DEV_T0000000000.wav \
./icefall-asr-zipformer-wenetspeech-20230615/test_wavs/DEV_T0000000001.wav \
./icefall-asr-zipformer-wenetspeech-20230615/test_wavs/DEV_T0000000002.wav
```

---

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

---

**Caution:** If you use Windows and get encoding issues, please run:

CHCP 65001

in your commandline.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./
build/bin/sherpa-onnx-offline --tokens=./icefall-asr-zipformer-wenetspeech-20230615/
data/lang_char/tokens.txt --encoder=./icefall-asr-zipformer-wenetspeech-20230615/exp/
encoder-epoch-12-avg-4.onnx --decoder=./icefall-asr-zipformer-wenetspeech-20230615/exp/
decoder-epoch-12-avg-4.onnx --joiner=./icefall-asr-zipformer-wenetspeech-20230615/exp/
joiner-epoch-12-avg-4.onnx ./icefall-asr-zipformer-wenetspeech-20230615/test_wavs/DEV_
T0000000000.wav ./icefall-asr-zipformer-wenetspeech-20230615/test_wavs/DEV_T0000000001.
wav ./icefall-asr-zipformer-wenetspeech-20230615/test_wavs/DEV_T0000000002.wav

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,
feature_dim=80), model_
config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="./
icefall-asr-zipformer-wenetspeech-20230615/exp/encoder-epoch-12-avg-4.onnx", decoder_
filename="./icefall-asr-zipformer-wenetspeech-20230615/exp/decoder-epoch-12-avg-4.onnx
", joiner_filename="./icefall-asr-zipformer-wenetspeech-20230615/exp/joiner-epoch-12-
avg-4.onnx"), paraformer=OfflineParaformerModelConfig(model=""), nemo_
ctc=OfflineNemoEncDecCtcModelConfig(model=""), tokens="./icefall-asr-zipformer-wenetspeech-20230615/data/lang_char/tokens.txt", num_threads=2, debug=False, provider="cpu"), lm_config=OfflineLMConfig(model="", scale=0.5), decoding_method="greedy_search
402, max_active_paths=4, context_score=1.5)
```

(continued from previous page)

```
Creating recognizer ...
Started
Done!

./icefall-asr-zipformer-wenetspeech-20230615/test_wavs/DEV_T00000000000.wav
{"text":"","timestamps":"[0.00, 0.12, 0.48, 0.64, 0.88, 1.16, 1.64, 1.76, 1.92, 2.08, 2.
↪ 32, 2.48, 2.64, 3.08, 3.20, 3.40, 3.48, 3.64, 3.76, 3.88, 3.96, 4.12, 4.28, 4.52, 4.72,
↪ 4.84]", "tokens": ["", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", ""]
↪ "", "", "", ""]}
-----
./icefall-asr-zipformer-wenetspeech-20230615/test_wavs/DEV_T00000000001.wav
{"text":"","timestamps":"[0.00, 0.16, 0.48, 0.72, 0.92, 1.08, 1.28, 1.52, 1.92, 2.08, 2.
↪ 52, 2.64, 2.88, 3.04, 3.20, 3.40, 3.56, 3.76, 3.84, 4.00, 4.16, 4.32, 4.56, 4.84]", "tokens": ["", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", ""]}
-----
./icefall-asr-zipformer-wenetspeech-20230615/test_wavs/DEV_T00000000002.wav
{"text":"","timestamps":"[0.00, 0.32, 0.56, 0.84, 1.12, 1.44, 1.68, 1.84, 2.28, 2.48, 2.
↪ 76, 2.92, 3.12, 3.28, 3.44, 3.60, 3.72, 3.92, 4.20]", "tokens": ["", "", "", "", "", "", "", "", "", "", "", ""]}
-----
num threads: 2
decoding method: greedy_search
Elapsed seconds: 0.458 s
Real time factor (RTF): 0.458 / 15.289 = 0.030
```

int8

The following code shows how to use `int8` models to decode wave files:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./icefall-asr-zipformer-wenetspeech-20230615/data/lang_char/tokens.txt \
--encoder=./icefall-asr-zipformer-wenetspeech-20230615/exp/encoder-epoch-12-avg-4.int8.
→ onnx \
--decoder=./icefall-asr-zipformer-wenetspeech-20230615/exp/decoder-epoch-12-avg-4.onnx
→ \
--joiner=./icefall-asr-zipformer-wenetspeech-20230615/exp/joiner-epoch-12-avg-4.int8.
→ onnx \
./icefall-asr-zipformer-wenetspeech-20230615/test_wavs/DEV_T0000000000.wav \
./icefall-asr-zipformer-wenetspeech-20230615/test_wavs/DEV_T0000000001.wav \
./icefall-asr-zipformer-wenetspeech-20230615/test_wavs/DEV_T0000000002.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

**Caution:** If you use Windows and get encoding issues, please run:

CHCP 65001

in your commandline.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./  
~/build/bin/sherpa-onnx-offline --tokens=./icefall-asr-zipformer-wenetspeech-20230615/  
~/data/lang_char/tokens.txt --encoder=./icefall-asr-zipformer-wenetspeech-20230615/exp/  
encoder-epoch-12-avg-4.int8.onnx --decoder=./icefall-asr-zipformer-wenetspeech-  
20230615/exp/decoder-epoch-12-avg-4.onnx --joiner=./icefall-asr-zipformer-wenetspeech-  
20230615/exp/joiner-epoch-12-avg-4.int8.onnx ./icefall-asr-zipformer-wenetspeech-  
20230615/test_wavs/DEV_T0000000000.wav ./icefall-asr-zipformer-wenetspeech-20230615/  
test_wavs/DEV_T0000000001.wav ./icefall-asr-zipformer-wenetspeech-20230615/test_wavs/  
DEV_T0000000002.wav  
  
OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,  
feature_dim=80), model_  
config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="~/  
icefall-asr-zipformer-wenetspeech-20230615/exp/encoder-epoch-12-avg-4.int8.onnx",  
decoder_filename="~/icefall-asr-zipformer-wenetspeech-20230615/exp/decoder-epoch-12-  
avg-4.onnx", joiner_filename="~/icefall-asr-zipformer-wenetspeech-20230615/exp/joiner-  
epoch-12-avg-4.int8.onnx"), paraformer=OfflineParaformerModelConfig(model=""), nemo_  
ctc=OfflineNemoEncDecCtcModelConfig(model=""), tokens="~/icefall-asr-zipformer-  
wenetspeech-20230615/data/lang_char/tokens.txt", num_threads=2, debug=False, provider=  
"cpu"), lm_config=OfflineLMConfig(model="", scale=0.5), decoding_method="greedy_search  
", max_active_paths=4, context_score=1.5)  
Creating recognizer ...  
Started  
Done!  
  
.icefall-asr-zipformer-wenetspeech-20230615/test_wavs/DEV_T0000000000.wav  
{"text": "", "timestamps": "[0.00, 0.12, 0.48, 0.60, 0.80, 1.08, 1.64, 1.76, 1.92, 2.08, 2.  
32, 2.48, 2.64, 3.08, 3.20, 3.28, 3.44, 3.60, 3.72, 3.84, 3.92, 4.12, 4.28, 4.48, 4.72,  
4.84]", "tokens": ["", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "",  
""]}  
---  
.icefall-asr-zipformer-wenetspeech-20230615/test_wavs/DEV_T0000000001.wav  
{"text": "", "timestamps": "[0.00, 0.16, 0.48, 0.68, 0.84, 1.08, 1.20, 1.48, 1.64, 2.08, 2.  
36, 2.52, 2.64, 2.84, 3.00, 3.16, 3.40, 3.52, 3.72, 3.84, 4.00, 4.16, 4.32, 4.56, 4.84]  
", "tokens": ["", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "",  
""]}  
---  
.icefall-asr-zipformer-wenetspeech-20230615/test_wavs/DEV_T0000000002.wav  
{"text": "", "timestamps": "[0.00, 0.12, 0.48, 0.84, 1.08, 1.44, 1.60, 1.84, 2.24, 2.48, 2.  
76, 2.88, 3.12, 3.24, 3.28, 3.36, 3.60, 3.72, 3.84, 4.16]", "tokens": ["", "", "", "",  
""]}  
---  
num threads: 2  
decoding method: greedy_search  
Elapsed seconds: 0.338 s  
Real time factor (RTF): 0.338 / 15.289 = 0.022
```

## Speech recognition from a microphone

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-microphone-offline \
--tokens=./icefall-asr-zipformer-wenetspeech-20230615/data/lang_char/tokens.txt \
--encoder=./icefall-asr-zipformer-wenetspeech-20230615/exp/encoder-epoch-12-avg-4.onnx \
--decoder=./icefall-asr-zipformer-wenetspeech-20230615/exp/decoder-epoch-12-avg-4.onnx \
--joiner=./icefall-asr-zipformer-wenetspeech-20230615/exp/joiner-epoch-12-avg-4.onnx
```

## csukuangfj/sherpa-onnx-zipformer-large-en-2023-06-26 (English)

This model is converted from

<https://huggingface.co/Zengwei/icefall-asr-librispeech-zipformer-large-2023-05-16>

which supports only English as it is trained on the [LibriSpeech](#) corpus.

You can find the training code at

<https://github.com/k2-fsa/icefall/tree/master/egs/librispeech/ASR/zipformer>

In the following, we describe how to download it and use it with `sherpa-onnx`.

### Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
zipformer-large-en-2023-06-26.tar.bz2

# For Chinese users, you can use the following mirror
# wget https://hub.nuua.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
zipformer-large-en-2023-06-26.tar.bz2

tar xvf sherpa-onnx-zipformer-large-en-2023-06-26.tar.bz2
rm sherpa-onnx-zipformer-large-en-2023-06-26.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of `*.onnx` files below.

```
sherpa-onnx-zipformer-large-en-2023-06-26 fangjun$ ls -lh *.onnx
-rw-r--r-- 1 fangjun staff 1.2M Jun 26 13:19 decoder-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 fangjun staff 2.0M Jun 26 13:19 decoder-epoch-99-avg-1.onnx
-rw-r--r-- 1 fangjun staff 145M Jun 26 13:20 encoder-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 fangjun staff 564M Jun 26 13:22 encoder-epoch-99-avg-1.onnx
-rw-r--r-- 1 fangjun staff 253K Jun 26 13:19 joiner-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 fangjun staff 1.0M Jun 26 13:19 joiner-epoch-99-avg-1.onnx
```

## Decode wave files

---

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

---

### fp32

The following code shows how to use fp32 models to decode wave files:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./sherpa-onnx-zipformer-large-en-2023-06-26/tokens.txt \
--encoder=./sherpa-onnx-zipformer-large-en-2023-06-26/encoder-epoch-99-avg-1.onnx \
--decoder=./sherpa-onnx-zipformer-large-en-2023-06-26/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-zipformer-large-en-2023-06-26/joiner-epoch-99-avg-1.onnx \
./sherpa-onnx-zipformer-large-en-2023-06-26/test_wavs/0.wav \
./sherpa-onnx-zipformer-large-en-2023-06-26/test_wavs/1.wav \
./sherpa-onnx-zipformer-large-en-2023-06-26/test_wavs/8k.wav
```

---

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

---

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./
↳ build/bin/sherpa-onnx-offline --tokens=./sherpa-onnx-zipformer-large-en-2023-06-26/
↳ tokens.txt --encoder=./sherpa-onnx-zipformer-large-en-2023-06-26/encoder-epoch-99-avg-
↳ 1.onnx --decoder=./sherpa-onnx-zipformer-large-en-2023-06-26/decoder-epoch-99-avg-1.
↳ onnx --joiner=./sherpa-onnx-zipformer-large-en-2023-06-26/joiner-epoch-99-avg-1.onnx ./
↳ sherpa-onnx-zipformer-large-en-2023-06-26/test_wavs/0.wav ./sherpa-onnx-zipformer-
↳ large-en-2023-06-26/test_wavs/1.wav ./sherpa-onnx-zipformer-large-en-2023-06-26/test-
↳ wavs/8k.wav

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,_
↳ feature_dim=80), model_
↳ config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="./
↳ sherpa-onnx-zipformer-large-en-2023-06-26/encoder-epoch-99-avg-1.onnx", decoder_
↳ filename="./sherpa-onnx-zipformer-large-en-2023-06-26/decoder-epoch-99-avg-1.onnx",_
↳ joiner_filename="./sherpa-onnx-zipformer-large-en-2023-06-26/joiner-epoch-99-avg-1.onnx
↳ "), paraformer=OfflineParaformerModelConfig(model=""), nemo_
↳ ctc=OfflineNemoEncDecCtcModelConfig(model=""), tokens="./sherpa-onnx-zipformer-large-
↳ en-2023-06-26/tokens.txt", num_threads=2, debug=False, provider="cpu"), lm_
↳ config=OfflineLMConfig(model="", scale=0.5), decoding_method="greedy_search", max_
↳ active_paths=4, context_score=1.5)
Creating recognizer ...
Started
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/offline-stream.
↳ cc:AcceptWaveformImpl:108 Creating a resampler:
    in_sample_rate: 8000
```

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```

output_sample_rate: 16000

Done!

./sherpa-onnx-zipformer-large-en-2023-06-26/test_wavs/0.wav
{"text":" AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE_
↪SQUALID QUARTER OF THE BROTHELS","timestamps":[0.00, 0.48, 0.60, 0.72, 1.04, 1.28, 1.
↪36, 1.48, 1.60, 1.84, 1.96, 2.00, 2.16, 2.32, 2.40, 2.48, 2.60, 2.80, 3.04, 3.28, 3.40,
↪3.56, 3.76, 4.04, 4.24, 4.28, 4.48, 4.64, 4.80, 4.84, 5.00, 5.04, 5.28, 5.40, 5.56, 5.
↪60, 5.76, 5.96, 6.16],"tokens":[" AFTER", " E", "AR", "LY", " NIGHT", "F", "A", "LL", " THE",
↪" YE", "LL", "OW", " LA", "M", "P", "S", " WOULD", " LIGHT", " UP", " HE", "RE", " AND", " THERE", "THE",
↪" S", "QUA", "LI", "D", " ", "QUA", "R", "TER", " OF", " THE", " B", "RO", "TH", "EL", "S"]}

-----
./sherpa-onnx-zipformer-large-en-2023-06-26/test_wavs/1.wav
{"text":" GOD AS A DIRECT CONSEQUENCE OF THE SIN WHICH MAN THUS PUNISHED HAD GIVEN HER A_
↪LOVELY CHILD WHOSE PLACE WAS ON THAT SAME DISHONORED BOSOM TO CONNECT HER PARENT FOR_
↪EVER WITH THE RACE AND DESCENT OF MORTALS AND TO BE FINALLY A BLESSED SOUL IN HEAVEN",
↪"timestamps":[0.00, 0.20, 0.48, 0.72, 0.88, 1.04, 1.12, 1.20, 1.36, 1.52, 1.68, 1.84,
↪1.88, 2.00, 2.12, 2.32, 2.36, 2.60, 2.84, 3.12, 3.24, 3.48, 3.56, 3.76, 3.92, 4.12, 4.
↪36, 4.56, 4.72, 4.96, 5.16, 5.44, 5.68, 6.12, 6.28, 6.48, 6.88, 7.12, 7.36, 7.56, 7.92,
↪8.16, 8.28, 8.40, 8.48, 8.60, 8.76, 8.88, 9.08, 9.28, 9.44, 9.52, 9.60, 9.72, 9.92,
↪10.00, 10.12, 10.48, 10.68, 10.76, 11.00, 11.20, 11.36, 11.56, 11.76, 12.00, 12.12, 12.
↪28, 12.32, 12.52, 12.72, 12.84, 12.92, 13.04, 13.20, 13.44, 13.64, 13.76, 14.00, 14.12,
↪14.24, 14.36, 14.52, 14.72, 14.80, 15.04, 15.28, 15.52, 15.76, 16.00, 16.20, 16.24,
↪16.32],"tokens":[" GO", "D", " AS", " A", " DI", "RE", "C", "T", " CON", "SE", "QUE", "N", "CE", "O
↪F", " THE", " S", "IN", " WHICH", " MAN", " TH", "US", " P", "UN", "ISH", "ED", " HAD", " GIVE", "N
↪", " HER", " A", " LOVE", "LY", " CHILD", " WHO", "SE", " PLACE", " WAS", " ON", " THAT", " SAME",
↪" DIS", "HO", "N", "OR", "ED", " BO", "S", "OM", " TO", " CON", "NE", "C", "T", " HER", " P", "AR",
↪"ENT", " FOR", " E", "VER", " WITH", " THE", " RA", "CE", " AND", " DE", "S", "C", "ENT", " OF", " MO
↪", "R", "T", "AL", "S", " AND", " TO", " BE", " FI", "N", "AL", "LY", " A", " B", "LESS", "ED", " SO",
↪"UL", " IN", " HE", "A", "VE", "N"]}

-----
./sherpa-onnx-zipformer-large-en-2023-06-26/test_wavs/8k.wav
{"text":" YET THESE THOUGHTS AFFECTED HESTER PRYNNE LESS WITH HOPE THAN APPREHENSION",
↪"timestamps":[0.00, 0.12, 0.36, 0.48, 0.76, 0.96, 1.12, 1.24, 1.32, 1.44, 1.48, 1.68,
↪1.76, 1.88, 2.04, 2.12, 2.24, 2.28, 2.48, 2.56, 2.80, 3.08, 3.28, 3.52, 3.80, 3.92, 4.
↪00, 4.16, 4.24, 4.36, 4.44],"tokens":[" YE", "T", " THE", "SE", " THOUGHT", "S", " A", "FF",
↪"E", "C", "TED", " HE", "S", "TER", " P", "RY", "N", "NE", " ", "LESS", " WITH", " HO", "PE", " THAN",
↪" A", "PP", "RE", "HE", "N", "S", "ION"]}

-----
num threads: 2
decoding method: greedy_search
Elapsed seconds: 1.843 s
Real time factor (RTF): 1.843 / 28.165 = 0.065

```

**int8**

The following code shows how to use int8 models to decode wave files:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./sherpa-onnx-zipformer-large-en-2023-06-26/tokens.txt \
--encoder=./sherpa-onnx-zipformer-large-en-2023-06-26/encoder-epoch-99-avg-1.int8.onnx \
--decoder=./sherpa-onnx-zipformer-large-en-2023-06-26/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-zipformer-large-en-2023-06-26/joiner-epoch-99-avg-1.int8.onnx \
./sherpa-onnx-zipformer-large-en-2023-06-26/test_wavs/0.wav \
./sherpa-onnx-zipformer-large-en-2023-06-26/test_wavs/1.wav \
./sherpa-onnx-zipformer-large-en-2023-06-26/test_wavs/8k.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./
build/bin/sherpa-onnx-offline --tokens=./sherpa-onnx-zipformer-large-en-2023-06-26/
tokens.txt --encoder=./sherpa-onnx-zipformer-large-en-2023-06-26/encoder-epoch-99-avg-
1.int8.onnx --decoder=./sherpa-onnx-zipformer-large-en-2023-06-26/decoder-epoch-99-avg-
1.onnx --joiner=./sherpa-onnx-zipformer-large-en-2023-06-26/joiner-epoch-99-avg-1.int8.
onnx ./sherpa-onnx-zipformer-large-en-2023-06-26/test_wavs/0.wav ./sherpa-onnx-
zipformer-large-en-2023-06-26/test_wavs/1.wav ./sherpa-onnx-zipformer-large-en-2023-06-
26/test_wavs/8k.wav

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,
feature_dim=80), model_
config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="./
sherpa-onnx-zipformer-large-en-2023-06-26/encoder-epoch-99-avg-1.int8.onnx", decoder_
filename="./sherpa-onnx-zipformer-large-en-2023-06-26/decoder-epoch-99-avg-1.onnx",
joiner_filename="./sherpa-onnx-zipformer-large-en-2023-06-26/joiner-epoch-99-avg-1.
int8.onnx"), paraformer=OfflineParaformerModelConfig(model=""), nemo_
ctc=OfflineNemoEncDecCtcModelConfig(model=""), tokens="./sherpa-onnx-zipformer-large-
en-2023-06-26/tokens.txt", num_threads=2, debug=False, provider="cpu"), lm_
config=OfflineLMConfig(model="", scale=0.5), decoding_method="greedy_search", max_
active_paths=4, context_score=1.5)
Creating recognizer ...
Started
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/offline-stream.
cc:AcceptWaveformImpl:108 Creating a resampler:
in_sample_rate: 8000
output_sample_rate: 16000

Done!

./sherpa-onnx-zipformer-large-en-2023-06-26/test_wavs/0.wav
{"text":" AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE_
SQUALID QUARTER OF THE BROTHELS","timestamps":[0.00, 0.48, 0.60, 0.72, 1.04, 1.28, 1.
36, 1.48, 1.60, 1.84, 1.96, 2.00, 2.16, 2.32, 2.40, 2.48, 2.60, 2.80, 3.04, 3.28, 3.40]
, 3.56, 3.76, 4.04, 4.24, 4.28, 4.48, 4.64, 4.80, 4.84, 5.00, 5.04, 5.28, 5.40, 5.56, 5.
60, 5.76, 5.96, 6.16],"tokens":[" AFTER", " E", " AR", " LY", " NIGHT", " F", " A", " LL", " THE",
" YE", " LL", " OW", " LA", " M", " P", " S", " WOULD", " LIGHT", " UP", " HE", " RE", " AND", " THERE",
" THE", " S", " QUA", " LI", " D", " ", " QUA", " R", " TER", " OF", " THE", " B", " RO", " TH", " EL", " S"]}
```

(continued from previous page)

```
-----
./sherpa-onnx-zipformer-large-en-2023-06-26/test_wavs/1.wav
{"text":" GOD AS A DIRECT CONSEQUENCE OF THE SIN WHICH MAN THUS PUNISHED HAD GIVEN HER A_
↳ LOVELY CHILD WHOSE PLACE WAS ON THAT SAME DISHONORED BOSOM TO CONNECT HER PARENT FOR_
↳ EVER WITH THE RACE AND DESCENT OF MORTALS AND TO BE FINALLY A BLESSED SOUL IN HEAVEN",
↳ "timestamps":[0.00, 0.20, 0.48, 0.72, 0.88, 1.04, 1.12, 1.20, 1.36, 1.52, 1.64, 1.84,
↳ 1.88, 2.00, 2.12, 2.32, 2.36, 2.60, 2.84, 3.12, 3.24, 3.48, 3.56, 3.76, 3.92, 4.12, 4.
↳ 36, 4.52, 4.72, 4.96, 5.16, 5.44, 5.68, 6.12, 6.28, 6.48, 6.88, 7.12, 7.36, 7.56, 7.92,
↳ 8.16, 8.28, 8.40, 8.48, 8.60, 8.76, 8.88, 9.08, 9.28, 9.44, 9.52, 9.60, 9.72, 9.92,_
↳ 10.00, 10.12, 10.48, 10.68, 10.76, 11.00, 11.20, 11.36, 11.56, 11.76, 12.00, 12.12, 12.
↳ 28, 12.32, 12.52, 12.72, 12.84, 12.92, 13.04, 13.20, 13.44, 13.64, 13.76, 14.00, 14.08,
↳ 14.24, 14.36, 14.52, 14.72, 14.76, 15.04, 15.28, 15.52, 15.76, 16.00, 16.20, 16.24,
↳ 16.32]", "tokens": ["GO", "D", "AS", "A", "DI", "RE", "C", "T", "CON", "SE", "QUE", "N", "CE",
↳ "OF", "THE", "S", "IN", "WHICH", "MAN", "TH", "US", "P", "UN", "ISH", "ED", "HAD", "GIVE", "N
↳ ", "HER", "A", "LOVE", "LY", "CHILD", "WHO", "SE", "PLACE", "WAS", "ON", "THAT", "SAME",
↳ "DIS", "HO", "N", "OR", "ED", "BO", "S", "OM", "TO", "CON", "NE", "C", "T", "HER", "P", "AR",
↳ "ENT", "FOR", "E", "VER", "WITH", "THE", "RA", "CE", "AND", "DE", "S", "C", "ENT", "OF", "MO
↳ ", "R", "T", "AL", "S", "AND", "TO", "BE", "FI", "N", "AL", "LY", "A", "B", "LESS", "ED", "SO",
↳ "UL", "IN", "HE", "A", "VE", "N"]}

-----
./sherpa-onnx-zipformer-large-en-2023-06-26/test_wavs/8k.wav
{"text":" YET THESE THOUGHTS AFFECTED HESTER PRYNNE LESS WITH HOPE THAN APPREHENSION",
↳ "timestamps":[0.00, 0.12, 0.36, 0.48, 0.76, 0.96, 1.12, 1.24, 1.32, 1.44, 1.48, 1.68,
↳ 1.76, 1.88, 2.04, 2.12, 2.28, 2.32, 2.48, 2.52, 2.80, 3.08, 3.28, 3.52, 3.76, 3.92, 4.
↳ 00, 4.16, 4.24, 4.36, 4.44]", "tokens": ["YE", "T", "THE", "SE", "THOUGHT", "S", "A", "FF",
↳ "E", "C", "TED", "HE", "S", "TER", "P", "RY", "N", "NE", "LESS", "WITH", "HO", "PE", "THAN",
↳ "A", "PP", "RE", "HE", "N", "S", "ION"]}

-----
num threads: 2
decoding method: greedy_search
Elapsed seconds: 1.490 s
Real time factor (RTF): 1.490 / 28.165 = 0.053
```

## Speech recognition from a microphone

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-microphone-offline \
--tokens=./sherpa-onnx-zipformer-large-en-2023-06-26/tokens.txt \
--encoder=./sherpa-onnx-zipformer-large-en-2023-06-26/encoder-epoch-99-avg-1.onnx \
--decoder=./sherpa-onnx-zipformer-large-en-2023-06-26/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-zipformer-large-en-2023-06-26/joiner-epoch-99-avg-1.onnx
```

## csukuangfj/sherpa-onnx-zipformer-small-en-2023-06-26 (English)

This model is converted from

<https://huggingface.co/Zengwei/icefall-asr-librispeech-zipformer-small-2023-05-16>

which supports only English as it is trained on the [LibriSpeech](#) corpus.

You can find the training code at

<https://github.com/k2-fsa/icefall/tree/master/egs/librispeech/ASR/zipformer>

In the following, we describe how to download it and use it with [sherpa-onnx](#).

### Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
↪zipformer-small-en-2023-06-26.tar.bz2

# For Chinese users, you can use the following mirror
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
↪zipformer-small-en-2023-06-26.tar.bz2

tar xvf sherpa-onnx-zipformer-small-en-2023-06-26.tar.bz2
rm sherpa-onnx-zipformer-small-en-2023-06-26.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of \*.onnx files below.

```
sherpa-onnx-zipformer-small-en-2023-06-26 fangjun$ ls -lh *.onnx
-rw-r--r-- 1 fangjun staff  1.2M Jun 26 13:04 decoder-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 fangjun staff  2.0M Jun 26 13:04 decoder-epoch-99-avg-1.onnx
-rw-r--r-- 1 fangjun staff   25M Jun 26 13:04 encoder-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 fangjun staff   87M Jun 26 13:04 encoder-epoch-99-avg-1.onnx
-rw-r--r-- 1 fangjun staff  253K Jun 26 13:04 joiner-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 fangjun staff   1.0M Jun 26 13:04 joiner-epoch-99-avg-1.onnx
```

### Decode wave files

---

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

---

## fp32

The following code shows how to use fp32 models to decode wave files:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./sherpa-onnx-zipformer-small-en-2023-06-26/tokens.txt \
--encoder=./sherpa-onnx-zipformer-small-en-2023-06-26/encoder-epoch-99-avg-1.onnx \
--decoder=./sherpa-onnx-zipformer-small-en-2023-06-26/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-zipformer-small-en-2023-06-26/joiner-epoch-99-avg-1.onnx \
./sherpa-onnx-zipformer-small-en-2023-06-26/test_wavs/0.wav \
./sherpa-onnx-zipformer-small-en-2023-06-26/test_wavs/1.wav \
./sherpa-onnx-zipformer-small-en-2023-06-26/test_wavs/8k.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./
build/bin/sherpa-onnx-offline --tokens=./sherpa-onnx-zipformer-small-en-2023-06-26/
tokens.txt --encoder=./sherpa-onnx-zipformer-small-en-2023-06-26/encoder-epoch-99-avg-
1.onnx --decoder=./sherpa-onnx-zipformer-small-en-2023-06-26/decoder-epoch-99-avg-1.
onnx --joiner=./sherpa-onnx-zipformer-small-en-2023-06-26/joiner-epoch-99-avg-1.onnx ./
sherpa-onnx-zipformer-small-en-2023-06-26/test_wavs/0.wav ./sherpa-onnx-zipformer-
small-en-2023-06-26/test_wavs/1.wav ./sherpa-onnx-zipformer-small-en-2023-06-26/test_
wavs/8k.wav

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,_
feature_dim=80), model_-
config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="./
sherpa-onnx-zipformer-small-en-2023-06-26/encoder-epoch-99-avg-1.onnx", decoder_
filename="./sherpa-onnx-zipformer-small-en-2023-06-26/decoder-epoch-99-avg-1.onnx",_
joiner_filename="./sherpa-onnx-zipformer-small-en-2023-06-26/joiner-epoch-99-avg-1.onnx
"), paraformer=OfflineParaformerModelConfig(model=""), nemo_-
ctc=OfflineNemoEncDecCtcModelConfig(model=""), tokens="./sherpa-onnx-zipformer-small-
en-2023-06-26/tokens.txt", num_threads=2, debug=False, provider="cpu"), lm_
config=OfflineLMConfig(model="", scale=0.5), decoding_method="greedy_search", max_
active_paths=4, context_score=1.5)
Creating recognizer ...
Started
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/offline-stream.
cc:AcceptWaveformImpl:108 Creating a resampler:
in_sample_rate: 8000
output_sample_rate: 16000

Done!

./sherpa-onnx-zipformer-small-en-2023-06-26/test_wavs/0.wav
{"text":" AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE_
SQUALID QUARTER OF THE BROTHELS", "timestamps": "[0.00, 0.64, 0.76, 0.84, 1.12, 1.36, 1.
44, 1.56, 1.72, 1.84, 1.96, 2.04, 2.20, 2.32, 2.36, 2.44, 2.60, 2.76, 3.04, 3.24, 3.40,
3.52, 3.72, 4.04, 4.20, 4.28, 4.48, 4.64, 4.80, 4.84, 4.96, 5.00, 5.28, (6.40 bytes on page)
60, 5.76, 5.92, 6.08]", "tokens": ["' AFTER", " E", "AR", "LY", " NIGHT", "F", "A", "LL", " THE",
" YE", "LL", "OW", " LA", "M", "P", "S", " WOULD", " LIGHT", " UP", " HE", "RE", " AND", " THERE",
"THE", "S", "QUA", "LI", "D", " ", "QUA", "R", "TER", " OF", " THE", " B", "RO", "TH", "EL", "S"]}
```

(continued from previous page)

```
-----
./sherpa-onnx-zipformer-small-en-2023-06-26/test_wavs/1.wav
{"text":" GOD AS A DIRECT CONSEQUENCE OF THE SIN WHICH MAN THUS PUNISHED HAD GIVEN HER A_
↳ LOVELY CHILD WHOSE PLACE WAS ON THAT SAME DISHONoured BOSOM TO CONNECT HER PARENT_
↳ FOREVER WITH THE RACE AND DESCENT OF MORTALS AND TO BE FINALLY A BLESSED SOUL IN HEAVEN
↳ ","timestamps":[0.00, 0.32, 0.64, 0.80, 0.96, 1.08, 1.16, 1.20, 1.32, 1.52, 1.68, 1.
↳ 80, 1.88, 2.04, 2.16, 2.32, 2.40, 2.64, 2.88, 3.16, 3.20, 3.44, 3.52, 3.72, 3.88, 4.16,
↳ 4.44, 4.60, 4.76, 4.96, 5.16, 5.36, 5.60, 6.16, 6.32, 6.52, 6.88, 7.16, 7.32, 7.60, 7.
↳ 96, 8.16, 8.28, 8.36, 8.48, 8.64, 8.76, 8.84, 9.04, 9.28, 9.44, 9.52, 9.60, 9.68, 9.88,
↳ 9.92, 10.12, 10.52, 10.76, 10.80, 11.08, 11.20, 11.36, 11.56, 11.76, 11.96, 12.08, 12.
↳ 24, 12.28, 12.48, 12.68, 12.80, 12.92, 13.00, 13.20, 13.48, 13.72, 13.84, 14.04, 14.20,
↳ 14.28, 14.40, 14.56, 14.68, 14.76, 15.00, 15.24, 15.48, 15.68, 15.92, 16.08, 16.12,_
↳ 16.20],"tokens":[" GO","D"," AS"," A"," DI","RE","C","T"," CON","SE","QUE","N","CE","_
↳ OF"," THE"," S","IN"," WHICH"," MAN"," TH","US"," P","UN","ISH","ED"," HAD"," GIVE","N
↳ "," HER"," A"," LOVE","LY"," CHILD"," WHO","SE"," PLACE"," WAS"," ON"," THAT"," SAME",
↳ " DIS","HO","N","OUR","ED"," BO","S","OM"," TO"," CON","NE","C","T"," HER"," P","AR",
↳ "ENT"," FOR","E","VER"," WITH"," THE"," RA","CE"," AND"," DE","S","C","ENT"," OF"," MO
↳ ","R","T","AL","S"," AND"," TO"," BE"," FI","N","AL","LY"," A"," B","LESS","ED"," SO",
↳ "UL"," IN"," HE","A","VE","N"]}

-----
./sherpa-onnx-zipformer-small-en-2023-06-26/test_wavs/8k.wav
{"text":" YET THESE THOUGHTS AFFECTED HESTER PRYNNE LESS WITH HOPE THAN APPREHENSION",
↳ "timestamps":[0.00, 0.32, 0.48, 0.64, 0.84, 1.08, 1.20, 1.32, 1.36, 1.44, 1.48, 1.64,
↳ 1.76, 1.88, 2.08, 2.12, 2.24, 2.28, 2.44, 2.48, 2.80, 3.04, 3.24, 3.48, 3.72, 3.88, 3.
↳ 92, 4.08, 4.16, 4.24, 4.36],"tokens":[" YE","T"," THE","SE"," THOUGHT","S"," A","FF",
↳ "E","C","TED"," HE","S","TER"," P","RY","N","NE"," ","LESS"," WITH"," HO","PE"," THAN",
↳ " A","PP","RE","HE","N","S","ION"]}

-----
num threads: 2
decoding method: greedy_search
Elapsed seconds: 0.953 s
Real time factor (RTF): 0.953 / 28.165 = 0.034
```

## int8

The following code shows how to use `int8` models to decode wave files:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./sherpa-onnx-zipformer-small-en-2023-06-26/tokens.txt \
--encoder=./sherpa-onnx-zipformer-small-en-2023-06-26/encoder-epoch-99-avg-1.int8.onnx \
--decoder=./sherpa-onnx-zipformer-small-en-2023-06-26/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-zipformer-small-en-2023-06-26/joiner-epoch-99-avg-1.int8.onnx \
./sherpa-onnx-zipformer-small-en-2023-06-26/test_wavs/0.wav \
./sherpa-onnx-zipformer-small-en-2023-06-26/test_wavs/1.wav \
./sherpa-onnx-zipformer-small-en-2023-06-26/test_wavs/8k.wav
```

---

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

---

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./  
build/bin/sherpa-onnx-offline --tokens=./sherpa-onnx-zipformer-small-en-2023-06-26/  
tokens.txt --encoder=./sherpa-onnx-zipformer-small-en-2023-06-26/encoder-epoch-99-avg-  
1.int8.onnx --decoder=./sherpa-onnx-zipformer-small-en-2023-06-26/decoder-epoch-99-avg-  
1.onnx --joiner=./sherpa-onnx-zipformer-small-en-2023-06-26/joiner-epoch-99-avg-1.int8.  
onnx ./sherpa-onnx-zipformer-small-en-2023-06-26/test_wavs/0.wav ./sherpa-onnx-  
zipformer-small-en-2023-06-26/test_wavs/1.wav ./sherpa-onnx-zipformer-small-en-2023-06-  
26/test_wavs/8k.wav

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,  
feature_dim=80), model_  
config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="./  
sherpa-onnx-zipformer-small-en-2023-06-26/encoder-epoch-99-avg-1.int8.onnx", decoder_  
filename="./sherpa-onnx-zipformer-small-en-2023-06-26/decoder-epoch-99-avg-1.onnx",  
joiner_filename="./sherpa-onnx-zipformer-small-en-2023-06-26/joiner-epoch-99-avg-1.  
int8.onnx"), paraformer=OfflineParaformerModelConfig(model=""), nemo_  
ctc=OfflineNemoEncDecCtcModelConfig(model=""), tokens="./sherpa-onnx-zipformer-small-  
en-2023-06-26/tokens.txt", num_threads=2, debug=False, provider="cpu"), lm_  
config=OfflineLMConfig(model="", scale=0.5), decoding_method="greedy_search", max_  
active_paths=4, context_score=1.5)
Creating recognizer ...
Started
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/offline-stream.  
cc:AcceptWaveformImpl:108 Creating a resampler:  
    in_sample_rate: 8000  
    output_sample_rate: 16000
```

Done!

```
./sherpa-onnx-zipformer-small-en-2023-06-26/test_wavs/0.wav
{"text":" AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE  
SQUALID QUARTER OF THE BROTHELS","timestamps":[0.00, 0.64, 0.76, 0.84, 1.08, 1.36, 1.  
44, 1.56, 1.72, 1.84, 1.96, 2.04, 2.20, 2.32, 2.36, 2.44, 2.60, 2.76, 3.04, 3.24, 3.40,  
3.52, 3.72, 4.00, 4.20, 4.28, 4.48, 4.64, 4.80, 4.84, 4.96, 5.00, 5.28, 5.40, 5.52, 5.  
60, 5.76, 5.92, 6.08],"tokens":[" AFTER", " E", "AR", "LY", " NIGHT", "F", "A", "LL", " THE",  
" YE", "LL", "OW", " LA", "M", "P", "S", " WOULD", " LIGHT", " UP", " HE", "RE", " AND", " THERE", "  
THE", " S", "QUA", "LI", "D", " ", "QUA", "R", "TER", " OF", " THE", " B", "RO", "TH", "EL", "S"]}  
---  
./sherpa-onnx-zipformer-small-en-2023-06-26/test_wavs/1.wav
{"text":" GOD AS A DIRECT CONSEQUENCE OF THE SIN WHICH MAN THUS PUNISHED HAD GIVEN HER A  
LOVELY CHILD WHOSE PLACE WAS ON THAT SAME DISHONORED BOSOM TO CONNECT HER PARENT  
FOREVER WITH THE RACE AND DESCENT OF MORTALS AND TO BE FINALLY A BLESSED SOUL IN HEAVEN  
","timestamps":[0.00, 0.32, 0.64, 0.80, 0.96, 1.08, 1.16, 1.20, 1.32, 1.52, 1.68, 1.  
80, 1.88, 2.04, 2.16, 2.32, 2.40, 2.64, 2.88, 3.16, 3.20, 3.44, 3.52, 3.72, 3.88, 4.16,  
4.44, 4.60, 4.76, 4.96, 5.16, 5.36, 5.60, 6.16, 6.32, 6.52, 6.88, 7.16, 7.32, 7.60, 7.  
96, 8.16, 8.28, 8.36, 8.48, 8.64, 8.76, 8.84, 9.04, 9.28, 9.44, 9.52, 9.60, 9.68, 9.88,  
9.92, 10.12, 10.52, 10.76, 10.80, 11.08, 11.20, 11.36, 11.56, 11.76, 11.96, 12.08, 12.  
24, 12.28, 12.48, 12.68, 12.80, 12.92, 13.04, 13.16, 13.48, 13.72, 13.84, 14.04, 14.20,  
14.28, 14.40, 14.56, 14.68, 14.76, 15.00, 15.28, 15.48, 15.68, 15.92, 16.08, 16.12, 16.16, 16.20],"tokens":[" GO", "D", " AS", " A", " DI", "RE", "C", "T", " CON", "SE", "QUE", "N", "CE", "  
OF", " THE", " S", "IN", " WHICH", " MAN", " TH", "US", " P", "UN", "ISH", "ED", " HAD", " GIVE", "N  
8.22, " Pre-trained models", " HER", " A", " LOVE", "LY", " CHILD", " WHO", "SE", " PLACE", " WAS", " ON", " THAT", " SAME", 413  
" DIS", "HO", "N", "OUR", "ED", " BO", "S", "OM", " TO", " CON", "NE", "C", "T", " HER", " P", "AR",  
"ENT", " FOR", "E", "VER", " WITH", " THE", " RA", "CE", " AND", " DE", "S", "C", "ENT", " OF", " MO  
", "R", "T", "AL", "S", " AND", " TO", " BE", " FI", "N", "AL", "LY", " A", " B", "LESS", "ED", " SO",
```

(continued from previous page)

```
----  
./sherpa-onnx-zipformer-small-en-2023-06-26/test_wavs/8k.wav  
{"text":" YET THESE THOUGHTS AFFECTED HESTER PRYNNE LESS WITH HOPE THAN APPREHENSION",  
 "timestamps":[0.00, 0.32, 0.48, 0.64, 0.84, 1.08, 1.20, 1.32, 1.36, 1.44, 1.48, 1.64, 1.  
 76, 1.88, 2.08, 2.12, 2.24, 2.28, 2.44, 2.48, 2.80, 3.04, 3.24, 3.48, 3.72, 3.88, 3.  
 92, 4.08, 4.16, 4.24, 4.36],"tokens":[" YE","T"," THE","SE"," THOUGHT","S"," A","FF",  
 "E","C","TED"," HE","S","TER"," P","RY","N","NE"," ","LESS"," WITH"," HO","PE"," THAN",  
 " A","PP","RE","HE","N","S","ION"]}  
----  
num threads: 2  
decoding method: greedy_search  
Elapsed seconds: 0.891 s  
Real time factor (RTF): 0.891 / 28.165 = 0.032
```

## Speech recognition from a microphone

```
cd /path/to/sherpa-onnx  
  
.build/bin/sherpa-onnx-microphone-offline \  
--tokens=./sherpa-onnx-zipformer-small-en-2023-06-26/tokens.txt \  
--encoder=./sherpa-onnx-zipformer-small-en-2023-06-26/encoder-epoch-99-avg-1.onnx \  
--decoder=./sherpa-onnx-zipformer-small-en-2023-06-26/decoder-epoch-99-avg-1.onnx \  
--joiner=./sherpa-onnx-zipformer-small-en-2023-06-26/joiner-epoch-99-avg-1.onnx
```

## csukuangfj/sherpa-onnx-zipformer-en-2023-06-26 (English)

This model is converted from

<https://huggingface.co/Zengwei/icefall-asr-librispeech-zipformer-2023-05-15>

which supports only English as it is trained on the [LibriSpeech](#) corpus.

You can find the training code at

<https://github.com/k2-fsa/icefall/tree/master/egs/librispeech/ASR/zipformer>

In the following, we describe how to download it and use it with [sherpa-onnx](#).

### Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx  
  
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-  
zipformer-en-2023-06-26.tar.bz2  
  
# For Chinese users, you can use the following mirror  
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-  
zipformer-en-2023-06-26.tar.bz2
```

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```
tar xvf sherpa-onnx-zipformer-en-2023-06-26.tar.bz2
rm sherpa-onnx-zipformer-en-2023-06-26.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of \*.onnx files below.

```
sherpa-onnx-zipformer-en-2023-06-26 fangjun$ ls -lh *.onnx
-rw-r--r-- 1 fangjun staff 1.2M Jun 26 12:45 decoder-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 fangjun staff 2.0M Jun 26 12:45 decoder-epoch-99-avg-1.onnx
-rw-r--r-- 1 fangjun staff 66M Jun 26 12:45 encoder-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 fangjun staff 248M Jun 26 12:46 encoder-epoch-99-avg-1.onnx
-rw-r--r-- 1 fangjun staff 253K Jun 26 12:45 joiner-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 fangjun staff 1.0M Jun 26 12:45 joiner-epoch-99-avg-1.onnx
```

## Decode wave files

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

### fp32

The following code shows how to use fp32 models to decode wave files:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./sherpa-onnx-zipformer-en-2023-06-26/tokens.txt \
--encoder=./sherpa-onnx-zipformer-en-2023-06-26/encoder-epoch-99-avg-1.onnx \
--decoder=./sherpa-onnx-zipformer-en-2023-06-26/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-zipformer-en-2023-06-26/joiner-epoch-99-avg-1.onnx \
./sherpa-onnx-zipformer-en-2023-06-26/test_wavs/0.wav \
./sherpa-onnx-zipformer-en-2023-06-26/test_wavs/1.wav \
./sherpa-onnx-zipformer-en-2023-06-26/test_wavs/8k.wav
```

**Note:** Please use ./build/bin/Release/sherpa-onnx-offline.exe for Windows.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./
↳ build/bin/sherpa-onnx-offline --tokens=./sherpa-onnx-zipformer-en-2023-06-26/tokens.
↳ txt --encoder=./sherpa-onnx-zipformer-en-2023-06-26/encoder-epoch-99-avg-1.onnx --
↳ decoder=./sherpa-onnx-zipformer-en-2023-06-26/decoder-epoch-99-avg-1.onnx --joiner=./
↳ sherpa-onnx-zipformer-en-2023-06-26/joiner-epoch-99-avg-1.onnx ./sherpa-onnx-zipformer-
↳ en-2023-06-26/test_wavs/0.wav ./sherpa-onnx-zipformer-en-2023-06-26/test_wavs/1.wav ./
↳ sherpa-onnx-zipformer-en-2023-06-26/test_wavs/8k.wav

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,
↳ feature_dim=80), model_ (continues on next page)
↳ config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="./
↳ sherpa-onnx-zipformer-en-2023-06-26/encoder-epoch-99-avg-1.onnx", decoder_filename="./
↳ sherpa-onnx-zipformer-en-2023-06-26/decoder-epoch-99-avg-1.onnx", joiner_filename="./
8.22. Pre-trained models 415
↳ sherpa-onnx-zipformer-en-2023-06-26/joiner-epoch-99-avg-1.onnx"), paraformer=OfflineParaformerModelConfig(model=""),
↳ ctc=OfflineNemoEncDecCtcModelConfig(model=""), tokens="./sherpa-onnx-zipformer-en-2023-
```

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```

Creating recognizer ...
Started
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/offline-stream.
→cc:AcceptWaveformImpl:108 Creating a resampler:
  in_sample_rate: 8000
  output_sample_rate: 16000

Done!

./sherpa-onnx-zipformer-en-2023-06-26/test_wavs/0.wav
{"text":" AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE
→SQUALID QUARTER OF THE BROTHELS","timestamps":[0.00, 0.56, 0.64, 0.80, 1.08, 1.36, 1.
→40, 1.52, 1.68, 1.84, 1.96, 2.04, 2.20, 2.32, 2.40, 2.48, 2.60, 2.80, 3.04, 3.28, 3.40,
→3.56, 3.76, 4.08, 4.24, 4.32, 4.48, 4.64, 4.80, 4.84, 5.00, 5.04, 5.28, 5.40, 5.56, 5.
→60, 5.76, 5.96, 6.12],"tokens":[" AFTER"," E","AR","LY"," NIGHT","F","A","LL"," THE",
→" YE","LL","OW"," LA","M","P","S"," WOULD"," LIGHT"," UP"," HE","RE"," AND"," THERE",
→" THE"," S","QUA","LI","D"," ","QUA","R","TER"," OF"," THE"," B","RO","TH","EL","S"]}

./sherpa-onnx-zipformer-en-2023-06-26/test_wavs/1.wav
{"text":" GOD AS A DIRECT CONSEQUENCE OF THE SIN WHICH MAN THUS PUNISHED HAD GIVEN HER A
→LOVELY CHILD WHOSE PLACE WAS ON THAT SAME DISHONORED BOSOM TO CONNECT HER PARENT
→FOREVER WITH THE RACE AND DESCENT OF MORTALS AND TO BE FINALLY A BLESSED SOUL IN HEAVEN
→","timestamps":[0.00, 0.24, 0.56, 0.76, 0.92, 1.04, 1.16, 1.20, 1.36, 1.52, 1.64, 1.
→80, 1.88, 2.00, 2.16, 2.32, 2.40, 2.64, 2.88, 3.12, 3.24, 3.48, 3.56, 3.72, 3.92, 4.12,
→4.40, 4.52, 4.72, 4.96, 5.16, 5.36, 5.64, 6.12, 6.28, 6.52, 6.88, 7.12, 7.32, 7.56, 7.
→92, 8.16, 8.28, 8.40, 8.48, 8.64, 8.76, 8.88, 9.04, 9.28, 9.44, 9.52, 9.60, 9.72, 9.92,
→9.96, 10.16, 10.48, 10.72, 10.80, 11.04, 11.20, 11.36, 11.56, 11.76, 12.00, 12.12, 12.
→28, 12.32, 12.52, 12.72, 12.84, 12.92, 13.04, 13.20, 13.44, 13.68, 13.84, 14.00, 14.16,
→14.28, 14.40, 14.56, 14.72, 14.76, 15.00, 15.28, 15.48, 15.68, 15.96, 16.16, 16.20,
→16.28],"tokens":[" GO","D"," AS"," A"," DI","RE","C","T"," CON","SE","QUE","N","CE",
→"OF"," THE"," S","IN"," WHICH"," MAN"," TH","US"," P","UN","ISH","ED"," HAD"," GIVE","N
→"," HER"," A"," LOVE","LY"," CHILD"," WHO","SE"," PLACE"," WAS"," ON"," THAT"," SAME",
→" DIS","HO","N","OR","ED"," BO","S","OM"," TO"," CON","NE","C","T"," HER"," P","AR",
→"ENT"," FOR","E","VER"," WITH"," THE"," RA","CE"," AND"," DE","S","C","ENT"," OF"," MO
→","R","T","AL","S"," AND"," TO"," BE"," FI","N","AL","LY"," A"," B","LESS","ED"," SO",
→"UL"," IN"," HE","A","VE","N"]}

./sherpa-onnx-zipformer-en-2023-06-26/test_wavs/8k.wav
{"text":" YET THESE THOUGHTS AFFECTED HESTER PRYNNE LESS WITH HOPE THAN APPREHENSION",
→"timestamps":[0.00, 0.24, 0.40, 0.60, 0.80, 1.04, 1.16, 1.28, 1.36, 1.44, 1.48, 1.68,
→1.76, 1.88, 2.00, 2.12, 2.24, 2.28, 2.48, 2.52, 2.80, 3.08, 3.28, 3.52, 3.68, 3.84, 3.
→96, 4.12, 4.20, 4.32, 4.44],"tokens":[" YE","T"," THE","SE"," THOUGHT","S"," A","FF",
→"E","C","TED"," HE","S","TER"," P","RY","N","NE"," ","LESS"," WITH"," HO","PE"," THAN",
→" A","PP","RE","HE","N","S","ION"]}

num threads: 2
decoding method: greedy_search
Elapsed seconds: 1.301 s
Real time factor (RTF): 1.301 / 28.165 = 0.046

```

**int8**

The following code shows how to use int8 models to decode wave files:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./sherpa-onnx-zipformer-en-2023-06-26/tokens.txt \
--encoder=./sherpa-onnx-zipformer-en-2023-06-26/encoder-epoch-99-avg-1.int8.onnx \
--decoder=./sherpa-onnx-zipformer-en-2023-06-26/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-zipformer-en-2023-06-26/joiner-epoch-99-avg-1.int8.onnx \
./sherpa-onnx-zipformer-en-2023-06-26/test_wavs/0.wav \
./sherpa-onnx-zipformer-en-2023-06-26/test_wavs/1.wav \
./sherpa-onnx-zipformer-en-2023-06-26/test_wavs/8k.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./
build/bin/sherpa-onnx-offline --tokens=./sherpa-onnx-zipformer-en-2023-06-26/tokens.
txt --encoder=./sherpa-onnx-zipformer-en-2023-06-26/encoder-epoch-99-avg-1.int8.onnx --
decoder=./sherpa-onnx-zipformer-en-2023-06-26/decoder-epoch-99-avg-1.onnx --joiner=./
sherpa-onnx-zipformer-en-2023-06-26/joiner-epoch-99-avg-1.int8.onnx ./sherpa-onnx-
zipformer-en-2023-06-26/test_wavs/0.wav ./sherpa-onnx-zipformer-en-2023-06-26/test_
wavs/1.wav ./sherpa-onnx-zipformer-en-2023-06-26/test_wavs/8k.wav

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,
feature_dim=80), model_
config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="./
sherpa-onnx-zipformer-en-2023-06-26/encoder-epoch-99-avg-1.int8.onnx", decoder_
filename="./sherpa-onnx-zipformer-en-2023-06-26/decoder-epoch-99-avg-1.onnx", joiner_
filename="./sherpa-onnx-zipformer-en-2023-06-26/joiner-epoch-99-avg-1.int8.onnx"),_
paraformer=OfflineParaformerModelConfig(model=""), nemo_
ctc=OfflineNemoEncDecCtcModelConfig(model=""), tokens="./sherpa-onnx-zipformer-en-2023-
06-26/tokens.txt", num_threads=2, debug=False, provider="cpu"), lm_
config=OfflineLMConfig(model="", scale=0.5), decoding_method="greedy_search", max_
active_paths=4, context_score=1.5)
Creating recognizer ...
Started
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/offline-stream.
cc:AcceptWaveformImpl:108 Creating a resampler:
  in_sample_rate: 8000
  output_sample_rate: 16000

Done!
./sherpa-onnx-zipformer-en-2023-06-26/test_wavs/0.wav
{"text":" AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE_
SQUALID QUARTER OF THE BROTHELS", "timestamps": "[0.00, 0.56, 0.64, 0.80, 1.08, 1.36, 1.
40, 1.52, 1.68, 1.84, 1.96, 2.04, 2.20, 2.32, 2.40, 2.48, 2.60, 2.76, 3.04, 3.28, 3.40,
3.56, 3.76, 4.08, 4.24, 4.32, 4.48, 4.64, 4.80, 4.84, 5.00, 5.04, 5.28, 5.40, 5.56, 5.
60, 5.76, 5.96, 6.12]", "tokens": [" AFTER", " E", "AR", "LY", " NIGHT", "F", "A"("çölliğüçün EME" page),
" YE", "LL", "OW", " LA", "M", "P", "S", " WOULD", " LIGHT", " UP", " HE", "RE", " AND", " THERE", " THE",
" S", "QUA", "LT", "D", " ", "QUA", "R", "TER", " OF", " THE", " B", "RO", "TH", "EL", "S"]}
```

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```
-----
./sherpa-onnx-zipformer-en-2023-06-26/test_wavs/1.wav
{"text":" GOD AS A DIRECT CONSEQUENCE OF THE SIN WHICH MAN THUS PUNISHED HAD GIVEN HER A_
↳ LOVELY CHILD WHOSE PLACE WAS ON THAT SAME DISHONORED BOSOM TO CONNECT HER PARENT_
↳ FOREVER WITH THE RACE AND DESCENT OF MORTALS AND TO BE FINALLY A BLESSED SOUL IN HEAVEN
↳ ","timestamps":[0.00, 0.24, 0.56, 0.76, 0.92, 1.04, 1.16, 1.20, 1.36, 1.52, 1.64, 1.
↳ 80, 1.88, 2.00, 2.16, 2.32, 2.40, 2.64, 2.88, 3.12, 3.24, 3.48, 3.56, 3.72, 3.92, 4.12,
↳ 4.40, 4.52, 4.72, 4.96, 5.12, 5.40, 5.64, 6.12, 6.28, 6.52, 6.88, 7.12, 7.32, 7.60, 7.
↳ 92, 8.16, 8.28, 8.40, 8.48, 8.64, 8.76, 8.88, 9.04, 9.28, 9.44, 9.52, 9.60, 9.72, 9.92,
↳ 9.96, 10.16, 10.48, 10.72, 10.80, 11.04, 11.20, 11.36, 11.56, 11.76, 12.00, 12.12, 12.
↳ 28, 12.32, 12.52, 12.72, 12.84, 12.92, 13.04, 13.20, 13.44, 13.68, 13.84, 14.00, 14.16,
↳ 14.28, 14.40, 14.56, 14.72, 14.76, 15.00, 15.28, 15.48, 15.68, 15.96, 16.16, 16.20,
↳ 16.28]","tokens":[" GO","D"," AS"," A"," DI","RE","C","T"," CON","SE","QUE","N","CE","
↳ OF"," THE"," S","IN"," WHICH"," MAN"," TH","US"," P","UN","ISH","ED"," HAD"," GIVE","N
↳ "," HER"," A"," LOVE","LY"," CHILD"," WHO","SE"," PLACE"," WAS"," ON"," THAT"," SAME",
↳ " DIS","HO","N","OR","ED"," BO","S","OM"," TO"," CON","NE","C","T"," HER"," P","AR",
↳ "ENT"," FOR","E","VER"," WITH"," THE"," RA","CE"," AND"," DE","S","C","ENT"," OF"," MO
↳ ","R","T","AL","S"," AND"," TO"," BE"," FI","N","AL","LY"," A"," B","LESS","ED"," SO",
↳ "UL"," IN"," HE","A","VE","N"]}

-----
./sherpa-onnx-zipformer-en-2023-06-26/test_wavs/8k.wav
{"text":" YET THESE THOUGHTS AFFECTED HESTER PRYNNE LESS WITH HOPE THAN APPREHENSION",
↳ "timestamps":[0.00, 0.24, 0.40, 0.60, 0.80, 1.04, 1.16, 1.28, 1.36, 1.44, 1.48, 1.68,
↳ 1.76, 1.88, 2.00, 2.08, 2.24, 2.28, 2.48, 2.52, 2.80, 3.08, 3.28, 3.52, 3.68, 3.84, 3.
↳ 96, 4.12, 4.20, 4.32, 4.44]","tokens":[" YE","T"," THE","SE"," THOUGHT","S"," A","FF",
↳ "E","C","TED"," HE","S","TER"," P","RY","N","NE"," ","LESS"," WITH"," HO","PE"," THAN",
↳ " A","PP","RE","HE","N","S","ION"]}

-----
num threads: 2
decoding method: greedy_search
Elapsed seconds: 1.106 s
Real time factor (RTF): 1.106 / 28.165 = 0.039
```

### Speech recognition from a microphone

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-microphone-offline \
--tokens=./sherpa-onnx-zipformer-en-2023-06-26/tokens.txt \
--encoder=./sherpa-onnx-zipformer-en-2023-06-26/encoder-epoch-99-avg-1.onnx \
--decoder=./sherpa-onnx-zipformer-en-2023-06-26/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-zipformer-en-2023-06-26/joiner-epoch-99-avg-1.onnx
```

**icefall-asr-multidataset-pruned\_transducer\_stateless7-2023-05-04 (English)**

This model is trained using GigaSpeech + LibriSpeech + Common Voice 13.0 with zipformer

See <https://github.com/k2-fsa/icefall/pull/1010> if you are interested in how it is trained.

In the following, we describe how to download it and use it with `sherpa-onnix`.

## Download the model

Please use the following commands to download it.

```
 wget https://github.com/k2-fsa/sherpa-onné/releases/download/asr-models/icefall-asr-  
 ↵ multidataset-pruned_transducer_stateless7-2023-05-04.tar.bz2  
  
 # For Chinese users, you can use the following mirror  
 # wget https://hub.nuaa.cf/k2-fsa/sherpa-onné/releases/download/asr-models/icefall-asr-  
 ↵ multidataset-pruned_transducer_stateless7-2023-05-04.tar.bz2  
  
 tar xvf icefall-asr-multidataset-pruned_transducer_stateless7-2023-05-04.tar.bz2  
 rm icefall-asr-multidataset-pruned_transducer_stateless7-2023-05-04.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of \*.onnx files below.

```
$ ls -lh *.onnx
-rw-r--r-- 1 fangjun staff  1.2M May 15 11:11 decoder-epoch-30-avg-4.int8.onnx
-rw-r--r-- 1 fangjun staff  2.0M May 15 11:11 decoder-epoch-30-avg-4.onnx
-rw-r--r-- 1 fangjun staff 121M May 15 11:12 encoder-epoch-30-avg-4.int8.onnx
-rw-r--r-- 1 fangjun staff 279M May 15 11:13 encoder-epoch-30-avg-4.onnx
-rw-r--r-- 1 fangjun staff 253K May 15 11:11 joiner-epoch-30-avg-4.int8.onnx
-rw-r--r-- 1 fangjun staff  1.0M May 15 11:11 joiner-epoch-30-avg-4.onnx
```

## Decode wave files

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

fp32

The following code shows how to use fp32 models to decode wave files:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./icefall-asr-multidataset-pruned_transducer_stateless7-2023-05-04/data/lang_
↪bpe_500/tokens.txt \
--encoder=./icefall-asr-multidataset-pruned_transducer_stateless7-2023-05-04/exp/
↪encoder-epoch-30-avg-4.onnx \
--decoder=./icefall-asr-multidataset-pruned_transducer_stateless7-2023-05-04/exp/
↪decoder-epoch-30-avg-4.onnx \
(continues on next page)
```

(continued from previous page)

```
--joiner=./icefall-asr-multidataset-pruned_transducer_stateless7-2023-05-04/exp/joiner-
↪epoch-30-avg-4.onnx \
./icefall-asr-multidataset-pruned_transducer_stateless7-2023-05-04/test_wavs/1089-
↪134686-0001.wav \
./icefall-asr-multidataset-pruned_transducer_stateless7-2023-05-04/test_wavs/1221-
↪135766-0001.wav \
./icefall-asr-multidataset-pruned_transducer_stateless7-2023-05-04/test_wavs/1221-
↪135766-0002.wav
```

---

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

---

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./
↪build/bin/sherpa-onnx-offline --tokens=./icefall-asr-multidataset-pruned_transducer-
↪stateless7-2023-05-04/data/lang_bpe_500/tokens.txt --encoder=./icefall-asr-
↪multidataset-pruned_transducer_stateless7-2023-05-04/exp/encoder-epoch-30-avg-4.onnx --
↪decoder=./icefall-asr-multidataset-pruned_transducer_stateless7-2023-05-04/exp/decoder-
↪epoch-30-avg-4.onnx --joiner=./icefall-asr-multidataset-pruned_transducer_stateless7-
↪2023-05-04/exp/joiner-epoch-30-avg-4.onnx ./icefall-asr-multidataset-pruned_transducer-
↪stateless7-2023-05-04/test_wavs/1089-134686-0001.wav ./icefall-asr-multidataset-pruned-
↪transducer_stateless7-2023-05-04/test_wavs/1221-135766-0001.wav ./icefall-asr-
↪multidataset-pruned_transducer_stateless7-2023-05-04/test_wavs/1221-135766-0002.wav

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,
↪feature_dim=80), model_
↪config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="./
↪icefall-asr-multidataset-pruned_transducer_stateless7-2023-05-04/exp/encoder-epoch-30-
↪avg-4.onnx", decoder_filename="./icefall-asr-multidataset-pruned_transducer_stateless7-
↪2023-05-04/exp/decoder-epoch-30-avg-4.onnx", joiner_filename="./icefall-asr-
↪multidataset-pruned_transducer_stateless7-2023-05-04/exp/joiner-epoch-30-avg-4.onnx"), 
↪paraformer=OfflineParaformerModelConfig(model=""), nemo_
↪ctc=OfflineNemoEncDecCtcModelConfig(model=""), tokens="./icefall-asr-
↪multidataset-pruned_transducer_stateless7-2023-05-04/data/lang_bpe_500/tokens.txt", num_threads=2,
↪debug=False, provider="cpu"), lm_config=OfflineLMConfig(model="", scale=0.5), decoding_
↪method="greedy_search", max_active_paths=4)
Creating recognizer ...
Started
Done!

./icefall-asr-multidataset-pruned_transducer_stateless7-2023-05-04/test_wavs/1089-134686-
↪0001.wav
{"text": " AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE_
↪SQUALID QUARTER OF THE BROTHELS", "timestamps": "[0.00, 0.40, 0.56, 0.64, 0.96, 1.24, 1.32, 1.
↪44, 1.56, 1.76, 1.88, 1.96, 2.16, 2.32, 2.36, 2.48, 2.60, 2.80, 3.08, 3.28, 3.36, 3.56, 3.80, 4.04, 4.
↪24, 4.32, 4.48, 4.64, 4.84, 4.88, 5.00, 5.08, 5.32, 5.44, 5.56, 5.64, 5.80, 5.96, 6.20]", "tokens": [
↪"AFTER", " E", "AR", "LY", " NIGHT", "F", "A", "LL", " THE", " YE", "LL", "OW", " LA", "M", "P", "S", ",
↪WOULD", " LIGHT", " UP", " HE", "RE", " AND", " THERE", " THE", " S", "QUA", "LI", "D", " ", "QUA",
↪"R", "TER", " OF", " THE", " B", "RO", "TH", "EL", "S"]}

...
./icefall-asr-multidataset-pruned_transducer_stateless7-2023-05-04/test_wavs/1221-135766-
↪0001.wav
```

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```
{"text":" GOD AS A DIRECT CONSEQUENCE OF THE SIN WHICH MAN THUS PUNISHED HAD GIVEN HER A_
↪ LOVELY CHILD WHOSE PLACE WAS ON THAT SAME DISHONORED BOSOM TO CONNECT HER PARENT FOR_
↪ EVER WITH THE RACE AND DESCENT OF MORTALS AND TO BE FINALLY A BLESSED SOUL IN HEAVEN",
↪ "timestamps":"[0.00,0.16,0.44,0.68,0.84,1.00,1.12,1.16,1.32,1.48,1.64,1.80,1.84,2.00,2.
↪ 12,2.28,2.40,2.64,2.88,3.16,3.28,3.56,3.60,3.76,3.92,4.12,4.36,4.52,4.72,4.92,5.16,5.
↪ 44,5.72,6.12,6.24,6.48,6.84,7.08,7.28,7.56,7.88,8.12,8.28,8.36,8.48,8.60,8.76,8.88,9.
↪ 12,9.28,9.48,9.56,9.64,9.80,10.00,10.04,10.20,10.44,10.68,10.80,11.04,11.20,11.40,11.
↪ 56,11.80,12.00,12.12,12.28,12.32,12.52,12.72,12.84,12.96,13.04,13.24,13.40,13.64,13.80,
↪ 14.00,14.16,14.24,14.36,14.56,14.72,14.80,15.08,15.32,15.52,15.76,16.04,16.16,16.24,16.
↪ 36]", "tokens": [" GO", "D", " AS", " A", " DI", "RE", "C", "T", " CON", "SE", "QUE", "N", "CE", " OF
↪ ", " THE", " S", "IN", " WHICH", " MAN", " TH", "US", " P", "UN", "ISH", "ED", " HAD", " GIVE", "N",
↪ " HER", " A", " LOVE", "LY", " CHILD", " WHO", "SE", " PLACE", " WAS", " ON", " THAT", " SAME", " DIS",
↪ "HO", "N", "OR", "ED", " BO", "S", "OM", " TO", " CON", "NE", "C", "T", " HER", " P", "AR", "ENT
↪ ", " FOR", " E", "VER", " WITH", " THE", " RA", "CE", " AND", " DE", "S", "C", "ENT", " OF", " R
↪ ", "T", "AL", "S", " AND", " TO", " BE", " FI", "N", "AL", "LY", " A", " B", "LESS", "ED", " SO", "UL",
↪ " IN", " HE", "A", "VE", "N"]}

----
```

```
./icefall-asr-multidataset-pruned_transducer_stateless7-2023-05-04/test_wavs/1221-135766-
↪ 0002.wav
```

```
{"text":" YET THESE THOUGHTS AFFECTED HESTER PRYNNE LESS WITH HOPE THAN APPREHENSION",
↪ "timestamps":"[0.00,0.08,0.32,0.48,0.68,0.92,1.08,1.20,1.28,1.40,1.44,1.64,1.76,1.88,2.
↪ 04,2.12,2.24,2.32,2.48,2.56,2.88,3.12,3.32,3.52,3.76,3.92,4.00,4.20,4.28,4.40,4.52]", "tokens": [" YE", "T", " THE", "SE", " THOUGHT", "S", " A", "FF", "E", "C", "TED", " HE", "S", "TER",
↪ " P", "RY", "N", "NE", " ", "LESS", " WITH", " HO", "PE", " THAN", " A", "PP", "RE", "HE", "N", "S",
↪ "ION"]}
```

```
----
```

```
num threads: 2
decoding method: greedy_search
Elapsed seconds: 1.662 s
Real time factor (RTF): 1.662 / 28.165 = 0.059
```

## int8

The following code shows how to use int8 models to decode wave files:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./icefall-asr-multidataset-pruned_transducer_stateless7-2023-05-04/data/lang_
↪ bpe_500/tokens.txt \
--encoder=./icefall-asr-multidataset-pruned_transducer_stateless7-2023-05-04/exp/
↪ encoder-epoch-30-avg-4.int8.onnx \
--decoder=./icefall-asr-multidataset-pruned_transducer_stateless7-2023-05-04/exp/
↪ decoder-epoch-30-avg-4.onnx \
--joiner=./icefall-asr-multidataset-pruned_transducer_stateless7-2023-05-04/exp/joiner-
↪ epoch-30-avg-4.int8.onnx \
./icefall-asr-multidataset-pruned_transducer_stateless7-2023-05-04/test_wavs/1089-
↪ 134686-0001.wav \
./icefall-asr-multidataset-pruned_transducer_stateless7-2023-05-04/test_wavs/1221-
↪ 135766-0001.wav \
./icefall-asr-multidataset-pruned_transducer_stateless7-2023-05-04/test_wavs/1221-
↪ 135766-0002.wav
```

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---

**Note:** Please use `./build/bin/Release/sherpa-onnéx-offline.exe` for Windows.

---

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnéx/sherpa-onnéx/csrc/parse-options.cc:Read:361 ./
↳ build/bin/sherpa-onnéx-offline --tokens=./icefall-asr-multidataset-pruned_transducer_
↳ stateless7-2023-05-04/data/lang_bpe_500/tokens.txt --encoder=./icefall-asr-
↳ multidataset-pruned_transducer_stateless7-2023-05-04/exp/encoder-epoch-30-avg-4.int8.
↳ onnx --decoder=./icefall-asr-multidataset-pruned_transducer_stateless7-2023-05-04/exp/
↳ decoder-epoch-30-avg-4.onnx --joiner=./icefall-asr-multidataset-pruned_transducer_
↳ stateless7-2023-05-04/exp/joiner-epoch-30-avg-4.int8.onnx ./icefall-asr-multidataset-
↳ pruned_transducer_stateless7-2023-05-04/test_wavs/1089-134686-0001.wav ./icefall-asr-
↳ multidataset-pruned_transducer_stateless7-2023-05-04/test_wavs/1221-135766-0001.wav ./
↳ icefall-asr-multidataset-pruned_transducer_stateless7-2023-05-04/test_wavs/1221-135766-
↳ 0002.wav

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,_
↳ feature_dim=80), model_
↳ config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="./
↳ icefall-asr-multidataset-pruned_transducer_stateless7-2023-05-04/exp/encoder-epoch-30-
↳ avg-4.int8.onnx", decoder_filename="./icefall-asr-multidataset-pruned_transducer_
↳ stateless7-2023-05-04/exp/decoder-epoch-30-avg-4.onnx", joiner_filename="./icefall-asr-
↳ multidataset-pruned_transducer_stateless7-2023-05-04/exp/joiner-epoch-30-avg-4.int8.
↳ onnx"), paraformer=OfflineParaformerModelConfig(model=""), nemo_
↳ ctc=OfflineNemoEncDecCtcModelConfig(model=""), tokens="./icefall-asr-multidataset-
↳ pruned_transducer_stateless7-2023-05-04/data/lang_bpe_500/tokens.txt", num_threads=2,_
↳ debug=False, provider="cpu"), lm_config=OfflineLMConfig(model="", scale=0.5), decoding_
↳ method="greedy_search", max_active_paths=4)
Creating recognizer ...
Started
Done!

./icefall-asr-multidataset-pruned_transducer_stateless7-2023-05-04/test_wavs/1089-134686-
↳ 0001.wav
{"text":" AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE_
↳ SQUALID QUARTER OF THE BROTHELS", "timestamps": "[0.00, 0.40, 0.56, 0.64, 0.96, 1.24, 1.32, 1.
↳ 44, 1.56, 1.76, 1.88, 1.96, 2.16, 2.32, 2.36, 2.48, 2.60, 2.80, 3.08, 3.28, 3.36, 3.56, 3.80, 4.04, 4.
↳ 24, 4.32, 4.48, 4.64, 4.84, 4.88, 5.00, 5.08, 5.32, 5.44, 5.56, 5.64, 5.80, 5.96, 6.20]", "tokens": [
↳ "AFTER", " E", "AR", "LY", " NIGHT", "F", "A", "LL", " THE", " YE", "LL", "OW", " LA", "M", "P", "S", " "
↳ "WOULD", " LIGHT", " UP", " HE", "RE", " AND", " THERE", " THE", " S", "QUA", "LI", "D", " ", "QUA",
↳ "R", "TER", " OF", " THE", " B", "RO", "TH", "EL", "S"]}

-----
./icefall-asr-multidataset-pruned_transducer_stateless7-2023-05-04/test_wavs/1221-135766-
↳ 0001.wav
{"text":" GOD AS A DIRECT CONSEQUENCE OF THE SIN WHICH MAN THUS PUNISHED HAD GIVEN HER A_
↳ LOVELY CHILD WHOSE PLACE WAS ON THAT SAME DISHONORED BOSOM TO CONNECT HER PARENT FOR_
↳ EVER WITH THE RACE AND DESCENT OF MORTALS AND TO BE FINALLY A BLESSED SOUL IN HEAVEN",
↳ "timestamps": "[0.00, 0.12, 0.44, 0.68, 0.80, 1.00, 1.12, 1.16, 1.32, 1.48, 1.64, 1.80, 1.84, 2.00, 2.
↳ 12, 2.28, 2.40, 2.64, 2.88, 3.16, 3.28, 3.56, 3.60, 3.76, 3.92, 4.12, 4.36, 4.52, 4.72, 4.92, 5.16, 5.
↳ 44, 5.72, 6.12, 6.24, 6.48, 6.84, 7.08, 7.28, 7.56, 7.88, 8.12, 8.28, 8.36, 8.48, 8.60, 8.76, 8.88, 9.
↳ 12, 9.28, 9.48, 9.56, 9.64, 9.80, 10.00, 10.04, 10.16, 10.44, 10.68, 10.80, 11.04, 11.20, 11.40, 11.
↳ 56, 11.80, 12.00, 12.16, 12.28, 12.32, 12.52, 12.72, 12.84, 12.96, 13.04, 13.24, 13.40, 13.64, 13.80,
4224.00, 14.16, 14.24, 14.36, 14.56, 14.72, 14.80, 15.08, 15.32, 15.52, 15.76, Chapter 8.1 sherpa-onnéx
36]", "tokens": [
↳ " GO", "D", " AS", " A", " DI", "RE", "C", "T", " CON", "SE", "QUE", "N", "CE", " OF
↳ " THE", " S", "IN", " WHICH", " MAN", " TH", "US", " P", "UN", "ISH", "ED", " HAD", " GIVE", "N",
↳ " HER", " A", " LOVE", "LY", " CHILD", " WHO", "SE", " PLACE", " WAS", " ON", " THAT", " SAME", " "
↳ " B", "RO", "TH", "EL", "S"]}
```

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```
-----
./icefall-asr-multidataset-pruned_transducer_stateless7-2023-05-04/test_wavs/1221-135766-
↪0002.wav
>{"text": " YET THESE THOUGHTS AFFECTED HESTER PRYNNE LESS WITH HOPE THAN APPREHENSION",
↪"timestamps": "[0.00, 0.08, 0.32, 0.48, 0.68, 0.92, 1.08, 1.20, 1.28, 1.40, 1.44, 1.64, 1.76, 1.88, 2.
↪04, 2.12, 2.28, 2.32, 2.52, 2.56, 2.88, 3.12, 3.32, 3.52, 3.76, 3.92, 4.00, 4.20, 4.28, 4.40, 4.52]", 
↪"tokens": ["YE", "T", "THE", "SE", "THOUGHT", "S", "A", "FF", "E", "C", "TED", "HE", "S", "TER",
↪"P", "RY", "N", "NE", "LESS", "WITH", "HO", "PE", "THAN", "A", "PP", "RE", "HE", "N", "S",
↪"ION"]}
```

-----

num threads: 2  
decoding method: greedy\_search  
Elapsed seconds: 1.424 s  
Real time factor (RTF): 1.424 / 28.165 = 0.051

## Speech recognition from a microphone

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-microphone-offline \
--tokens=./icefall-asr-multidataset-pruned_transducer_stateless7-2023-05-04/data/lang_
↪bpe_500/tokens.txt \
--encoder=./icefall-asr-multidataset-pruned_transducer_stateless7-2023-05-04/exp/
↪encoder-epoch-30-avg-4.onnx \
--decoder=./icefall-asr-multidataset-pruned_transducer_stateless7-2023-05-04/exp/
↪decoder-epoch-30-avg-4.onnx \
--joiner=./icefall-asr-multidataset-pruned_transducer_stateless7-2023-05-04/exp/joiner-
↪epoch-30-avg-4.onnx
```

## csukuangfj/sherpa-onnx-zipformer-en-2023-04-01 (English)

This model is converted from

<https://huggingface.co/WeijiZhuang/icefall-asr-librispeech-pruned-transducer-stateless8-2022-12-02>

which supports only English as it is trained on the LibriSpeech and GigaSpeech corpus.

You can find the training code at

[https://github.com/k2-fsa/icefall/tree/master/egs/librispeech/ASR/pruned\\_transducer\\_stateless8](https://github.com/k2-fsa/icefall/tree/master/egs/librispeech/ASR/pruned_transducer_stateless8)

In the following, we describe how to download it and use it with `sherpa-onnx`.

## Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
zipformer-en-2023-04-01.tar.bz2

# For Chinese users, please use the following mirror
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
# zipformer-en-2023-04-01.tar.bz2

tar xvf sherpa-onnx-zipformer-en-2023-04-01.tar.bz2
rm sherpa-onnx-zipformer-en-2023-04-01.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of \*.onnx files below.

```
sherpa-onnx-zipformer-en-2023-04-01$ ls -lh *.onnx
-rw-r--r-- 1 kuangfangjun root  1.3M Apr  1 14:34 decoder-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 kuangfangjun root  2.0M Apr  1 14:34 decoder-epoch-99-avg-1.onnx
-rw-r--r-- 1 kuangfangjun root 180M Apr  1 14:34 encoder-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 kuangfangjun root 338M Apr  1 14:34 encoder-epoch-99-avg-1.onnx
-rw-r--r-- 1 kuangfangjun root 254K Apr  1 14:34 joiner-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 kuangfangjun root 1003K Apr  1 14:34 joiner-epoch-99-avg-1.onnx
```

## Decode wave files

---

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

---

### fp32

The following code shows how to use fp32 models to decode wave files:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./sherpa-onnx-zipformer-en-2023-04-01/tokens.txt \
--encoder=./sherpa-onnx-zipformer-en-2023-04-01/encoder-epoch-99-avg-1.onnx \
--decoder=./sherpa-onnx-zipformer-en-2023-04-01/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-zipformer-en-2023-04-01/joiner-epoch-99-avg-1.onnx \
./sherpa-onnx-zipformer-en-2023-04-01/test_wavs/0.wav \
./sherpa-onnx-zipformer-en-2023-04-01/test_wavs/1.wav \
./sherpa-onnx-zipformer-en-2023-04-01/test_wavs/8k.wav
```

---

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

---

You should see the following output:

```
OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,
    ↪feature_dim=80), model_
    ↪config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="./
    ↪sherpa-onnx-zipformer-en-2023-04-01/encoder-epoch-99-avg-1.onnx", decoder_filename="./
    ↪sherpa-onnx-zipformer-en-2023-04-01/decoder-epoch-99-avg-1.onnx", joiner_filename="./
    ↪sherpa-onnx-zipformer-en-2023-04-01/joiner-epoch-99-avg-1.onnx"), ↪
    ↪paraformer=OfflineParaformerModelConfig(model="", tokens="./sherpa-onnx-zipformer-en-
    ↪2023-04-01/tokens.txt", num_threads=2, debug=False), decoding_method="greedy_search")
Creating recognizer ...
2023-04-01 14:40:56.353883875 [E:onnxruntime:, env.cc:251 ThreadMain] pthread_
    ↪setaffinity_np failed for thread: 638155, index: 16, mask: {17, 53, }, error code: 22
    ↪error msg: Invalid argument. Specify the number of threads explicitly so the affinity
    ↪is not set.
2023-04-01 14:40:56.353881478 [E:onnxruntime:, env.cc:251 ThreadMain] pthread_
    ↪setaffinity_np failed for thread: 638154, index: 15, mask: {16, 52, }, error code: 22
    ↪error msg: Invalid argument. Specify the number of threads explicitly so the affinity
    ↪is not set.
Started
Creating a resampler:
    in_sample_rate: 8000
    output_sample_rate: 16000

Done!

./sherpa-onnx-zipformer-en-2023-04-01/test_wavs/0.wav
AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID
    ↪QUARTER OF THE BROTHELS
---
./sherpa-onnx-zipformer-en-2023-04-01/test_wavs/1.wav
GOD AS A DIRECT CONSEQUENCE OF THE SIN WHICH MAN THUS PUNISHED HAD GIVEN HER A LOVELY
    ↪CHILD WHOSE PLACE WAS ON THAT SAME DISHONORED BOSOM TO CONNECT HER PARENT FOR EVER
    ↪WITH THE RACE AND DESCENT OF MORTALS AND TO BE FINALLY A BLESSED SOUL IN HEAVEN
---
./sherpa-onnx-zipformer-en-2023-04-01/test_wavs/8k.wav
YET THESE THOUGHTS AFFECTION HESTER PRYNNE LESS WITH HOPE THAN APPREHENSION
---
num threads: 2
decoding method: greedy_search
Elapsed seconds: 2.151 s
Real time factor (RTF): 2.151 / 28.165 = 0.076
```

## int8

The following code shows how to use int8 models to decode wave files:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
    --tokens=./sherpa-onnx-zipformer-en-2023-04-01/tokens.txt \
    --encoder=./sherpa-onnx-zipformer-en-2023-04-01/encoder-epoch-99-avg-1.int8.onnx \
```

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```
--decoder=./sherpa-onnx-zipformer-en-2023-04-01/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-zipformer-en-2023-04-01/joiner-epoch-99-avg-1.int8.onnx \
./sherpa-onnx-zipformer-en-2023-04-01/test_wavs/0.wav \
./sherpa-onnx-zipformer-en-2023-04-01/test_wavs/1.wav \
./sherpa-onnx-zipformer-en-2023-04-01/test_wavs/8k.wav
```

---

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

---

You should see the following output:

```
OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,
    ↵ feature_dim=80), model_
    ↵ config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="./
    ↵ sherpa-onnx-zipformer-en-2023-04-01/encoder-epoch-99-avg-1.int8.onnx", decoder_
    ↵ filename="./sherpa-onnx-zipformer-en-2023-04-01/decoder-epoch-99-avg-1.onnx", joiner_
    ↵ filename="./sherpa-onnx-zipformer-en-2023-04-01/joiner-epoch-99-avg-1.int8.onnx"), ↵
    ↵ paraformer=OfflineParaformerModelConfig(model=""), tokens="./sherpa-onnx-zipformer-en-
    ↵ 2023-04-01/tokens.txt", num_threads=2, debug=False), decoding_method="greedy_search")
Creating recognizer ...
2023-04-01 14:42:00.407939001 [E:onnxruntime:, env.cc:251 ThreadMain] pthread_
    ↵ setaffinity_np failed for thread: 638195, index: 15, mask: {16, 52, }, error code: 22
    ↵ error msg: Invalid argument. Specify the number of threads explicitly so the affinity
    ↵ is not set.
2023-04-01 14:42:00.407940827 [E:onnxruntime:, env.cc:251 ThreadMain] pthread_
    ↵ setaffinity_np failed for thread: 638196, index: 16, mask: {17, 53, }, error code: 22
    ↵ error msg: Invalid argument. Specify the number of threads explicitly so the affinity
    ↵ is not set.
Started
Creating a resampler:
    in_sample_rate: 8000
    output_sample_rate: 16000

Done!

./sherpa-onnx-zipformer-en-2023-04-01/test_wavs/0.wav
AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID
    ↵ QUARTER OF THE BROTHELS
-----
./sherpa-onnx-zipformer-en-2023-04-01/test_wavs/1.wav
GOD AS A DIRECT CONSEQUENCE OF THE SIN WHICH MAN THUS PUNISHED HAD GIVEN HER A LOVELY
    ↵ CHILD WHOSE PLACE WAS ON THAT SAME DISHONORED BOSOM TO CONNECT HER PARENT FOR EVER
    ↵ WITH THE RACE AND DESCENT OF MORTALS AND TO BE FINALLY A BLESSED SOUL IN HEAVEN
-----
./sherpa-onnx-zipformer-en-2023-04-01/test_wavs/8k.wav
YET THESE THOUGHTS AFFECTED HESTER PRYNNE LESS WITH HOPE THAN APPREHENSION
-----
num threads: 2
decoding method: greedy_search
Elapsed seconds: 1.478 s
Real time factor (RTF): 1.478 / 28.165 = 0.052
```

## Speech recognition from a microphone

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-microphone-offline \
--tokens=./sherpa-onnx-zipformer-en-2023-04-01/tokens.txt \
--encoder=./sherpa-onnx-zipformer-en-2023-04-01/encoder-epoch-99-avg-1.onnx \
--decoder=./sherpa-onnx-zipformer-en-2023-04-01/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-zipformer-en-2023-04-01/joiner-epoch-99-avg-1.onnx
```

### csukuangfj/sherpa-onnx-zipformer-en-2023-03-30 (English)

This model is converted from

<https://huggingface.co/csukuangfj/icefall-asr-librispeech-pruned-transducer-stateless7-2022-11-11>

which supports only English as it is trained on the [LibriSpeech](#) corpus.

You can find the training code at

[https://github.com/k2-fsa/icefall/tree/master/egs/librispeech/ASR/pruned\\_transducer\\_stateless7](https://github.com/k2-fsa/icefall/tree/master/egs/librispeech/ASR/pruned_transducer_stateless7)

In the following, we describe how to download it and use it with `sherpa-onnx`.

#### Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
zipformer-en-2023-03-30.tar.bz2

# For Chinese users, please use the following mirror
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
# zipformer-en-2023-03-30.tar.bz2

tar xvf sherpa-onnx-zipformer-en-2023-03-30.tar.bz2
rm sherpa-onnx-zipformer-en-2023-03-30.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of `*.onnx` files below.

```
sherpa-onnx-zipformer-en-2023-03-30$ ls -lh *.onnx
-rw-r--r-- 1 kuangfangjun root  1.3M Mar 31 00:37 decoder-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 kuangfangjun root  2.0M Mar 30 20:10 decoder-epoch-99-avg-1.onnx
-rw-r--r-- 1 kuangfangjun root 180M Mar 31 00:37 encoder-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 kuangfangjun root 338M Mar 30 20:10 encoder-epoch-99-avg-1.onnx
-rw-r--r-- 1 kuangfangjun root  254K Mar 31 00:37 joiner-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 kuangfangjun root 1003K Mar 30 20:10 joiner-epoch-99-avg-1.onnx
```

## Decode wave files

---

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

---

### fp32

The following code shows how to use fp32 models to decode wave files:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./sherpa-onnx-zipformer-en-2023-03-30/tokens.txt \
--encoder=./sherpa-onnx-zipformer-en-2023-03-30/encoder-epoch-99-avg-1.onnx \
--decoder=./sherpa-onnx-zipformer-en-2023-03-30/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-zipformer-en-2023-03-30/joiner-epoch-99-avg-1.onnx \
./sherpa-onnx-zipformer-en-2023-03-30/test_wavs/0.wav \
./sherpa-onnx-zipformer-en-2023-03-30/test_wavs/1.wav \
./sherpa-onnx-zipformer-en-2023-03-30/test_wavs/8k.wav
```

---

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

---

You should see the following output:

```
OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,
    feature_dim=80), model_
    config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="./
    sherpa-onnx-zipformer-en-2023-03-30/encoder-epoch-99-avg-1.onnx", decoder_filename="./
    sherpa-onnx-zipformer-en-2023-03-30/decoder-epoch-99-avg-1.onnx", joiner_filename="./
    sherpa-onnx-zipformer-en-2023-03-30/joiner-epoch-99-avg-1.onnx"),_
    paraformer=OfflineParaformerModelConfig(model=""), tokens="./sherpa-onnx-zipformer-en-
    2023-03-30/tokens.txt", num_threads=2, debug=False), decoding_method="greedy_search")
Creating recognizer ...
2023-04-01 06:47:56.620698024 [E:onnxruntime:, env.cc:251 ThreadMain] pthread_
    setaffinity_np failed for thread: 607690, index: 15, mask: {16, 52, }, error code: 22_
    error msg: Invalid argument. Specify the number of threads explicitly so the affinity_
    is not set.
2023-04-01 06:47:56.620700026 [E:onnxruntime:, env.cc:251 ThreadMain] pthread_
    setaffinity_np failed for thread: 607691, index: 16, mask: {17, 53, }, error code: 22_
    error msg: Invalid argument. Specify the number of threads explicitly so the affinity_
    is not set.
Started
Creating a resampler:
    in_sample_rate: 8000
    output_sample_rate: 16000

Done!
./sherpa-onnx-zipformer-en-2023-03-30/test_wavs/0.wav
```

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```

AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID ↵
↳ QUARTER OF THE BROTHELS
-----
./sherpa-onnx-zipformer-en-2023-03-30/test_wavs/1.wav
GOD AS A DIRECT CONSEQUENCE OF THE SIN WHICH MAN THUS PUNISHED HAD GIVEN HER A LOVELY ↵
↳ CHILD WHOSE PLACE WAS ON THAT SAME DISHONORED BOSOM TO CONNECT HER PARENT FOR EVER ↵
↳ WITH THE RACE AND DESCENT OF MORTALS AND TO BE FINALLY A BLESSED SOUL IN HEAVEN
-----
./sherpa-onnx-zipformer-en-2023-03-30/test_wavs/8k.wav
YET THESE THOUGHTS AFFECTED HESTER PRYNNE LESS WITH HOPE THAN APPREHENSION
-----
num threads: 2
decoding method: greedy_search
Elapsed seconds: 1.950 s
Real time factor (RTF): 1.950 / 28.165 = 0.069

```

## int8

The following code shows how to use int8 models to decode wave files:

```

cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./sherpa-onnx-zipformer-en-2023-03-30/tokens.txt \
--encoder=./sherpa-onnx-zipformer-en-2023-03-30/encoder-epoch-99-avg-1.int8.onnx \
--decoder=./sherpa-onnx-zipformer-en-2023-03-30/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-zipformer-en-2023-03-30/joiner-epoch-99-avg-1.int8.onnx \
./sherpa-onnx-zipformer-en-2023-03-30/test_wavs/0.wav \
./sherpa-onnx-zipformer-en-2023-03-30/test_wavs/1.wav \
./sherpa-onnx-zipformer-en-2023-03-30/test_wavs/8k.wav

```

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

You should see the following output:

```

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000, ↵
↳ feature_dim=80), model_ \
↳ config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="./ ↵
↳ sherpa-onnx-zipformer-en-2023-03-30/encoder-epoch-99-avg-1.int8.onnx", decoder_ \
↳ filename="./sherpa-onnx-zipformer-en-2023-03-30/decoder-epoch-99-avg-1.onnx", joiner_ \
↳ filename="./sherpa-onnx-zipformer-en-2023-03-30/joiner-epoch-99-avg-1.int8.onnx"), ↵
↳ paraformer=OfflineParaformerModelConfig(model=""), tokens="./sherpa-onnx-zipformer-en- ↵
↳ 2023-03-30/tokens.txt", num_threads=2, debug=False), decoding_method="greedy_search")
Creating recognizer ...
2023-04-01 06:49:34.370117205 [E:onnxruntime:, env.cc:251 ThreadMain] pthread_
↳ setaffinity_np failed for thread: 607732, index: 16, mask: {17, 53, }, error code: 22, ↵
↳ error msg: Invalid argument. Specify the number of threads explicitly so the affinity ↵
↳ is not set.
2023-04-01 06:49:34.370115197 [E:onnxruntime:, env.cc:251 ThreadMain] pthread_
↳ setaffinity_np failed for thread: 607731, index: 15, mask: {16, 52, }, error code: 22, ↵
↳ error msg: Invalid argument. Specify the number of threads explicitly so the affinity ↵
↳ is not set.

```

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```
Started
Creating a resampler:
  in_sample_rate: 8000
  output_sample_rate: 16000

Done!

./sherpa-onnx-zipformer-en-2023-03-30/test_wavs/0.wav
AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID_
→ QUARTER OF THE BROTHELS
-----
./sherpa-onnx-zipformer-en-2023-03-30/test_wavs/1.wav
GOD AS A DIRECT CONSEQUENCE OF THE SIN WHICH MAN THUS PUNISHED HAD GIVEN HER A LOVELY_
→ CHILD WHOSE PLACE WAS ON THAT SAME DISHONORED BOSOM TO CONNECT HER PARENT FOR EVER_
→ WITH THE RACE AND DESCENT OF MORTALS AND TO BE FINALLY A BLESSED SOUL IN HEAVEN
-----
./sherpa-onnx-zipformer-en-2023-03-30/test_wavs/8k.wav
YET THESE THOUGHTS AFFECTION HESTER PRYNNE LESS WITH HOPE THAN APPREHENSION
-----
num threads: 2
decoding method: greedy_search
Elapsed seconds: 1.710 s
Real time factor (RTF): 1.710 / 28.165 = 0.061
```

## Speech recognition from a microphone

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-microphone-offline \
--tokens=./sherpa-onnx-zipformer-en-2023-03-30/tokens.txt \
--encoder=./sherpa-onnx-zipformer-en-2023-03-30/encoder-epoch-99-avg-1.onnx \
--decoder=./sherpa-onnx-zipformer-en-2023-03-30/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-zipformer-en-2023-03-30/joiner-epoch-99-avg-1.onnx
```

## Conformer-transducer-based Models

---

**Hint:** Please refer to [Installation](#) to install `sherpa-onnx` before you read this section.

---

## csukuangfj/sherpa-onnx-conformer-zh-stateless2-2023-05-23 (Chinese)

This model is converted from

[https://huggingface.co/luomingshuang/icefall\\_asr\\_wenetspeech\\_pruned\\_transducer\\_stateless2](https://huggingface.co/luomingshuang/icefall_asr_wenetspeech_pruned_transducer_stateless2)

which supports only Chinese as it is trained on the [WenetSpeech](#) corpus.

You can find the training code at

[https://github.com/k2-fsa/icefall/tree/master/egs/wenetspeech/ASR/pruned\\_transducer\\_stateless2](https://github.com/k2-fsa/icefall/tree/master/egs/wenetspeech/ASR/pruned_transducer_stateless2)

In the following, we describe how to download it and use it with [sherpa-onnx](#).

### Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
↪conformer-zh-stateless2-2023-05-23.tar.bz2

# For Chinese users, you can use the following mirror
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
↪conformer-zh-stateless2-2023-05-23.tar.bz2

tar xvf sherpa-onnx-conformer-zh-stateless2-2023-05-23.tar.bz2
rm sherpa-onnx-conformer-zh-stateless2-2023-05-23.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of \*.onnx files below.

```
sherpa-onnx-conformer-zh-stateless2-2023-05-23 fangjun$ ls -lh *.onnx
-rw-r--r-- 1 fangjun staff 11M May 23 15:29 decoder-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 fangjun staff 12M May 23 15:29 decoder-epoch-99-avg-1.onnx
-rw-r--r-- 1 fangjun staff 122M May 23 15:30 encoder-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 fangjun staff 315M May 23 15:31 encoder-epoch-99-avg-1.onnx
-rw-r--r-- 1 fangjun staff 2.7M May 23 15:29 joiner-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 fangjun staff 11M May 23 15:29 joiner-epoch-99-avg-1.onnx
```

### Decode wave files

---

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

---

fp32

The following code shows how to use fp32 models to decode wave files:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnéx-offline \
--tokens=./sherpa-onnéx-conformer-zh-stateless2-2023-05-23/tokens.txt \
--encoder=./sherpa-onnéx-conformer-zh-stateless2-2023-05-23/encoder-epoch-99-avg-1.onnéx \
--decoder=./sherpa-onnéx-conformer-zh-stateless2-2023-05-23/decoder-epoch-99-avg-1.onnéx \
--joiner=./sherpa-onnéx-conformer-zh-stateless2-2023-05-23/joiner-epoch-99-avg-1.onnéx \
./sherpa-onnéx-conformer-zh-stateless2-2023-05-23/test_wavs/0.wav \
./sherpa-onnéx-conformer-zh-stateless2-2023-05-23/test_wavs/1.wav \
./sherpa-onnéx-conformer-zh-stateless2-2023-05-23/test_wavs/2.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./  
→ build/bin/sherpa-onnx-offline --tokens=./sherpa-onnx-conformer-zh-stateless2-2023-05-  
→ 23/tokens.txt --encoder=./sherpa-onnx-conformer-zh-stateless2-2023-05-23/encoder-epoch-  
→ 99-avg-1.onnx --decoder=./sherpa-onnx-conformer-zh-stateless2-2023-05-23/decoder-epoch-  
→ 99-avg-1.onnx --joiner=./sherpa-onnx-conformer-zh-stateless2-2023-05-23/joiner-epoch-  
→ 99-avg-1.onnx ./sherpa-onnx-conformer-zh-stateless2-2023-05-23/test_wavs/0.wav ./  
→ sherpa-onnx-conformer-zh-stateless2-2023-05-23/test_wavs/1.wav ./sherpa-onnx-conformer-  
→ zh-stateless2-2023-05-23/test_wavs/2.wav  
  
OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000, □  
→ feature_dim=80), model_=  
→ config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename=".//  
→ sherpa-onnx-conformer-zh-stateless2-2023-05-23/encoder-epoch-99-avg-1.onnx", decoder_=  
→ filename=".//sherpa-onnx-conformer-zh-stateless2-2023-05-23/decoder-epoch-99-avg-1.onnx  
→ ", joiner_filename=".//sherpa-onnx-conformer-zh-stateless2-2023-05-23/joiner-epoch-99-  
→ avg-1.onnx"), paraformer=OfflineParaformerModelConfig(model=""), nemo_=  
→ ctc=OfflineNemoEncDecCtcModelConfig(model=""), tokens=".//sherpa-onnx-conformer-zh-  
→ stateless2-2023-05-23/tokens.txt", num_threads=2, debug=False, provider="cpu"), lm_=  
→ config=OfflineLMConfig(model="", scale=0.5), decoding_method="greedy_search", max_=  
→ active_paths=4)  
Creating recognizer ...  
Started  
Done!  
  
../sherpa-onnx-conformer-zh-stateless2-2023-05-23/test_wavs/0.wav  
{"text": "", "timestamps": "[0.00, 0.12, 0.44, 0.64, 0.84, 1.04, 1.64, 1.72, 1.88, 2.08, 2.  
→ 28, 2.44, 2.56, 2.76, 3.08, 3.20, 3.32, 3.48, 3.64, 3.76, 3.88, 4.00, 4.16, 4.24, 4.44,  
→ 4.60, 4.84]", "tokens": ["", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "",  
→ "", "", "", "", "", "" ]}  
----  
../sherpa-onnx-conformer-zh-stateless2-2023-05-23/test_wavs/1.wav
```

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```
{"text":"","timestamps":[0.00, 0.12, 0.48, 0.64, 0.88, 1.08, 1.28, 1.48, 1.80, 2.12, 2.  
↳ 40, 2.56, 2.68, 2.88, 3.04, 3.16, 3.36, 3.56, 3.68, 3.84, 4.00, 4.16, 4.32, 4.56, 4.76]  
↳ ","tokens":["","","","","","","","","","","","","","","","","","","","","","","","","","","","","","",""]}  
----  
./sherpa-onnx-conformer-zh-stateless2-2023-05-23/test_wavs/2.wav  
{"text":"","timestamps":[0.00, 0.16, 0.60, 0.88, 1.08, 1.36, 1.64, 1.84, 2.24, 2.52, 2.  
↳ 72, 2.92, 3.08, 3.24, 3.40, 3.56, 3.72, 3.88, 4.12],"tokens":["","","","","","","","","","","","","","","","","","","","","","","","",""]}  
----  
num threads: 2  
decoding method: greedy_search  
Elapsed seconds: 0.596 s  
Real time factor (RTF): 0.596 / 15.289 = 0.039
```

**Caution:** If you use Windows and get encoding issues, please run:

CHCP 65001

in your commandline.

## int8

The following code shows how to use int8 models to decode wave files:

```
cd /path/to/sherpa-onnx  
  
./build/bin/sherpa-onnx-offline \  
  --tokens=./sherpa-onnx-conformer-zh-stateless2-2023-05-23/tokens.txt \  
  --encoder=./sherpa-onnx-conformer-zh-stateless2-2023-05-23/encoder-epoch-99-avg-1.int8.  
↳ onnx \  
  --decoder=./sherpa-onnx-conformer-zh-stateless2-2023-05-23/decoder-epoch-99-avg-1.onnx.  
↳ \  
  --joiner=./sherpa-onnx-conformer-zh-stateless2-2023-05-23/joiner-epoch-99-avg-1.int8.  
↳ onnx \  
  ./sherpa-onnx-conformer-zh-stateless2-2023-05-23/test_wavs/0.wav \  
  ./sherpa-onnx-conformer-zh-stateless2-2023-05-23/test_wavs/1.wav \  
  ./sherpa-onnx-conformer-zh-stateless2-2023-05-23/test_wavs/2.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

**Caution:** We did not use int8 for the decoder model above.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./  
build/bin/sherpa-onnx-offline --tokens=./sherpa-onnx-conformer-zh-stateless2-2023-05-  
23/tokens.txt --encoder=./sherpa-onnx-conformer-zh-stateless2-2023-05-23/encoder-epoch-  
99-avg-1.int8.onnx --decoder=./sherpa-onnx-conformer-zh-stateless2-2023-05-23/decoder-  
epoch-99-avg-1.onnx --joiner=./sherpa-onnx-conformer-zh-stateless2-2023-05-23/joiner-  
epoch-99-avg-1.int8.onnx ./sherpa-onnx-conformer-zh-stateless2-2023-05-23/test_wavs/0.  
wav ./sherpa-onnx-conformer-zh-stateless2-2023-05-23/test_wavs/1.wav ./sherpa-onnx-  
conformer-zh-stateless2-2023-05-23/test_wavs/2.wav  
  
OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,  
feature_dim=80), model_  
config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="./  
sherpa-onnx-conformer-zh-stateless2-2023-05-23/encoder-epoch-99-avg-1.int8.onnx",  
decoder_filename="./sherpa-onnx-conformer-zh-stateless2-2023-05-23/decoder-epoch-99-  
avg-1.onnx", joiner_filename="./sherpa-onnx-conformer-zh-stateless2-2023-05-23/joiner-  
epoch-99-avg-1.int8.onnx"), paraformer=OfflineParaformerModelConfig(model=""), nemo_  
ctc=OfflineNemoEncDecCtcModelConfig(model=""), tokens="./sherpa-onnx-conformer-zh-  
stateless2-2023-05-23/tokens.txt", num_threads=2, debug=False, provider="cpu"), lm_  
config=OfflineLMConfig(model="", scale=0.5), decoding_method="greedy_search", max_  
active_paths=4)  
Creating recognizer ...  
Started  
Done!  
  
. ./sherpa-onnx-conformer-zh-stateless2-2023-05-23/test_wavs/0.wav  
{"text": "", "timestamps": "[0.00, 0.12, 0.44, 0.64, 0.84, 1.08, 1.64, 1.72, 1.88, 2.08, 2.  
28, 2.44, 2.56, 2.76, 3.08, 3.20, 3.32, 3.48, 3.64, 3.76, 3.88, 4.00, 4.16, 4.24, 4.48,  
4.60, 4.84]", "tokens": ["", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "",  
"", "", "", "", "", "", ""]}  
---  
. ./sherpa-onnx-conformer-zh-stateless2-2023-05-23/test_wavs/1.wav  
{"text": "", "timestamps": "[0.00, 0.08, 0.48, 0.64, 0.88, 1.08, 1.28, 1.48, 1.80, 2.08, 2.  
40, 2.56, 2.68, 2.88, 3.04, 3.16, 3.36, 3.56, 3.68, 3.84, 4.00, 4.16, 4.32, 4.56, 4.76]  
", "tokens": ["", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "",  
""]}  
---  
. ./sherpa-onnx-conformer-zh-stateless2-2023-05-23/test_wavs/2.wav  
{"text": "", "timestamps": "[0.00, 0.12, 0.56, 0.84, 1.08, 1.40, 1.64, 1.84, 2.24, 2.52, 2.  
72, 2.92, 3.08, 3.24, 3.40, 3.56, 3.72, 3.88, 4.12]", "tokens": ["", "", "", "", "", "",  
"", "", "", "", "", "", "", "", ""]}  
---  
num threads: 2  
decoding method: greedy_search  
Elapsed seconds: 0.439 s  
Real time factor (RTF): 0.439 / 15.289 = 0.029
```

**Caution:** If you use Windows and get encoding issues, please run:

```
CHCP 65001
```

in your commandline.

## Speech recognition from a microphone

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-microphone-offline \
--tokens=./sherpa-onnx-conformer-zh-stateless2-2023-05-23/tokens.txt \
--encoder=./sherpa-onnx-conformer-zh-stateless2-2023-05-23/encoder-epoch-99-avg-1.onnx \
--decoder=./sherpa-onnx-conformer-zh-stateless2-2023-05-23/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-conformer-zh-stateless2-2023-05-23/joiner-epoch-99-avg-1.onnx
```

**Caution:** If you use Windows and get encoding issues, please run:

CHCP 65001

in your commandline.

## csukuangfj/sherpa-onnx-conformer-zh-2023-05-23 (Chinese)

This model is converted from

[https://huggingface.co/luomingshuang/icefall\\_asr\\_wenetspeech\\_pruned\\_transducer\\_stateless5\\_offline](https://huggingface.co/luomingshuang/icefall_asr_wenetspeech_pruned_transducer_stateless5_offline)

which supports only Chinese as it is trained on the [WenetSpeech](#) corpus.

You can find the training code at

[https://github.com/k2-fsa/icefall/tree/master/egs/wenetspeech/ASR/pruned\\_transducer\\_stateless5](https://github.com/k2-fsa/icefall/tree/master/egs/wenetspeech/ASR/pruned_transducer_stateless5)

In the following, we describe how to download it and use it with `sherpa-onnx`.

### Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
--conformer-zh-2023-05-23.tar.bz2

# For Chinese users, you can use the following mirror
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
--conformer-zh-2023-05-23.tar.bz2

tar xvf sherpa-onnx-conformer-zh-2023-05-23.tar.bz2
rm sherpa-onnx-conformer-zh-2023-05-23.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of `*.onnx` files below.

```
sherpa-onnx-conformer-zh-2023-05-23 fangjun$ ls -lh *.onnx
-rw-r--r-- 1 fangjun staff 11M May 23 13:45 decoder-epoch-99-avg-1.int8.onnx
```

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```
-rw-r--r-- 1 fangjun staff 12M May 23 13:45 decoder-epoch-99-avg-1.onnx
-rw-r--r-- 1 fangjun staff 129M May 23 13:47 encoder-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 fangjun staff 345M May 23 13:48 encoder-epoch-99-avg-1.onnx
-rw-r--r-- 1 fangjun staff 2.7M May 23 13:45 joiner-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 fangjun staff 11M May 23 13:45 joiner-epoch-99-avg-1.onnx
```

## Decode wave files

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

### fp32

The following code shows how to use fp32 models to decode wave files:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./sherpa-onnx-conformer-zh-2023-05-23/tokens.txt \
--encoder=./sherpa-onnx-conformer-zh-2023-05-23/encoder-epoch-99-avg-1.onnx \
--decoder=./sherpa-onnx-conformer-zh-2023-05-23/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-conformer-zh-2023-05-23/joiner-epoch-99-avg-1.onnx \
./sherpa-onnx-conformer-zh-2023-05-23/test_wavs/0.wav \
./sherpa-onnx-conformer-zh-2023-05-23/test_wavs/1.wav \
./sherpa-onnx-conformer-zh-2023-05-23/test_wavs/2.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./
↳ build/bin/sherpa-onnx-offline --tokens=./sherpa-onnx-conformer-zh-2023-05-23/tokens.
↳ txt --encoder=./sherpa-onnx-conformer-zh-2023-05-23/encoder-epoch-99-avg-1.onnx --
↳ decoder=./sherpa-onnx-conformer-zh-2023-05-23/decoder-epoch-99-avg-1.onnx --joiner=./
↳ sherpa-onnx-conformer-zh-2023-05-23/joiner-epoch-99-avg-1.onnx ./sherpa-onnx-conformer-
↳ zh-2023-05-23/test_wavs/0.wav ./sherpa-onnx-conformer-zh-2023-05-23/test_wavs/1.wav ./
↳ sherpa-onnx-conformer-zh-2023-05-23/test_wavs/2.wav

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000, ↳
↳ feature_dim=80), model_
↳ config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="./
↳ sherpa-onnx-conformer-zh-2023-05-23/encoder-epoch-99-avg-1.onnx", decoder_filename="./
↳ sherpa-onnx-conformer-zh-2023-05-23/decoder-epoch-99-avg-1.onnx", joiner_filename="./
↳ sherpa-onnx-conformer-zh-2023-05-23/joiner-epoch-99-avg-1.onnx"), ↳
↳ paraformer=OfflineParaformerModelConfig(model=""), nemo_
↳ ctc=OfflineNemoEncDecCtcModelConfig(model=""), tokens="./sherpa-onnx-conformer-zh-2023-
↳ 05-23/tokens.txt", num_threads=2, debug=False, provider="cpu"), lm_
↳ config=OfflineLMConfig(model="", scale=0.5), decoding_method="greedy_search", max_
↳ active_paths=4)
```

(continued from previous page)

```

Creating recognizer ...
Started
Done!

./sherpa-onnx-conformer-zh-2023-05-23/test_wavs/0.wav
{"text":"","timestamps":[0.00, 0.12, 0.52, 0.64, 0.84, 1.04, 1.68, 1.80, 1.92, 2.12, 2.
↪32, 2.48, 2.64, 2.76, 3.08, 3.20, 3.44, 3.52, 3.64, 3.76, 3.88, 4.00, 4.16, 4.32, 4.48,
↪4.64, 4.84],"tokens":["","","","","","","","","","","","","","","","","","","","","","","","","","","",
↪","","","","","","","",""]}

-----
./sherpa-onnx-conformer-zh-2023-05-23/test_wavs/1.wav
{"text":"","timestamps":[0.04, 0.16, 0.36, 0.48, 0.68, 0.92, 1.08, 1.24, 1.44, 1.84, 2.
↪08, 2.36, 2.52, 2.68, 2.88, 3.04, 3.16, 3.40, 3.56, 3.72, 3.84, 4.04, 4.16, 4.32, 4.56,
↪4.76],"tokens":["","","","","","","","","","","","","","","","","","","","","","","","","","","",
↪","","","",""]}

-----
./sherpa-onnx-conformer-zh-2023-05-23/test_wavs/2.wav
{"text":"","timestamps":[0.00, 0.12, 0.60, 0.84, 1.04, 1.44, 1.68, 1.84, 2.28, 2.52, 2.
↪80, 2.92, 3.08, 3.24, 3.40, 3.60, 3.72, 3.84, 4.12],"tokens":["","","","","","","","","",
↪","","","","","","","","","","","",""]}

-----
num threads: 2
decoding method: greedy_search
Elapsed seconds: 0.706 s
Real time factor (RTF): 0.706 / 15.289 = 0.046

```

**Caution:** If you use Windows and get encoding issues, please run:

CHCP 65001

in your commandline.

## int8

The following code shows how to use int8 models to decode wave files:

```

cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./sherpa-onnx-conformer-zh-2023-05-23/tokens.txt \
--encoder=./sherpa-onnx-conformer-zh-2023-05-23/encoder-epoch-99-avg-1.int8.onnx \
--decoder=./sherpa-onnx-conformer-zh-2023-05-23/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-conformer-zh-2023-05-23/joiner-epoch-99-avg-1.int8.onnx \
./sherpa-onnx-conformer-zh-2023-05-23/test_wavs/0.wav \
./sherpa-onnx-conformer-zh-2023-05-23/test_wavs/1.wav \
./sherpa-onnx-conformer-zh-2023-05-23/test_wavs/2.wav

```

**Note:** Please use ./build/bin/Release/sherpa-onnx-offline.exe for Windows.

**Caution:** We did not use int8 for the decoder model above.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./  
build/bin/sherpa-onnx-offline --decoding-method=greedy_search --tokens=./sherpa-onnx-  
conformer-zh-2023-05-23/tokens.txt --encoder=./sherpa-onnx-conformer-zh-2023-05-23/  
encoder-epoch-99-avg-1.int8.onnx --decoder=./sherpa-onnx-conformer-zh-2023-05-23/  
decoder-epoch-99-avg-1.onnx --joiner=./sherpa-onnx-conformer-zh-2023-05-23/joiner-  
epoch-99-avg-1.int8.onnx ./sherpa-onnx-conformer-zh-2023-05-23/test_wavs/0.wav ./  
sherpa-onnx-conformer-zh-2023-05-23/test_wavs/1.wav ./sherpa-onnx-conformer-zh-2023-05-  
23/test_wavs/2.wav  
  
OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,  
feature_dim=80), model_  
config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="./  
sherpa-onnx-conformer-zh-2023-05-23/encoder-epoch-99-avg-1.int8.onnx", decoder_  
filename="./sherpa-onnx-conformer-zh-2023-05-23/decoder-epoch-99-avg-1.onnx", joiner_  
filename="./sherpa-onnx-conformer-zh-2023-05-23/joiner-epoch-99-avg-1.int8.onnx"),  
paraformer=OfflineParaformerModelConfig(model=""), nemo_  
ctc=OfflineNemoEncDecCtcModelConfig(model=""), tokens="./sherpa-onnx-conformer-zh-2023-  
05-23/tokens.txt", num_threads=2, debug=False, provider="cpu"), lm_  
config=OfflineLMConfig(model="", scale=0.5), decoding_method="greedy_search", max_  
active_paths=4)  
Creating recognizer ...  
Started  
Done!  
  
. ./sherpa-onnx-conformer-zh-2023-05-23/test_wavs/0.wav  
{ "text": "", "timestamps": "[0.00, 0.12, 0.52, 0.64, 0.84, 1.04, 1.68, 1.80, 1.92, 2.08, 2.  
32, 2.48, 2.64, 2.76, 3.08, 3.20, 3.44, 3.52, 3.64, 3.76, 3.88, 4.00, 4.16, 4.32, 4.48,  
4.60, 4.84]", "tokens": [ "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "",  
" ", " ", " ", " ", " " ] }  
---  
. ./sherpa-onnx-conformer-zh-2023-05-23/test_wavs/1.wav  
{ "text": "", "timestamps": "[0.04, 0.16, 0.36, 0.48, 0.68, 0.92, 1.08, 1.24, 1.44, 1.88, 2.  
08, 2.36, 2.52, 2.64, 2.88, 3.00, 3.16, 3.40, 3.56, 3.72, 3.84, 4.04, 4.20, 4.32, 4.56,  
4.76]", "tokens": [ "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "",  
" ", " ", " " ] }  
---  
. ./sherpa-onnx-conformer-zh-2023-05-23/test_wavs/2.wav  
{ "text": "", "timestamps": "[0.00, 0.12, 0.60, 0.84, 1.04, 1.44, 1.64, 1.84, 2.28, 2.52, 2.  
80, 2.92, 3.08, 3.28, 3.36, 3.60, 3.72, 3.84, 4.12]", "tokens": [ "", "", "", "", "", "", "",  
" ", " ", " ", " ", " ", " ", " ", " " ] }  
---  
num threads: 2  
decoding method: greedy_search  
Elapsed seconds: 0.502 s  
Real time factor (RTF): 0.502 / 15.289 = 0.033
```

**Caution:** If you use Windows and get encoding issues, please run:

CHCP 65001

in your commandline.

## Speech recognition from a microphone

```
cd /path/to/sherpa-onnx  
  
./build/bin/sherpa-onnéx-microphone-offline \  
  --tokens=./sherpa-onnéx-conformer-zh-2023-05-23/tokens.txt \  
  --encoder=./sherpa-onnéx-conformer-zh-2023-05-23/encoder-epoch-99-avg-1.onnéx \  
  --decoder=./sherpa-onnéx-conformer-zh-2023-05-23/decoder-epoch-99-avg-1.onnéx \  
  --joiner=./sherpa-onnéx-conformer-zh-2023-05-23/joiner-epoch-99-avg-1.onnéx
```

**Caution:** If you use Windows and get encoding issues, please run:

CHCP 65001

in your commandline.

[csukuangfj/sherpa-onnéx-conformer-en-2023-03-18 \(English\)](#)

This model is converted from

<https://huggingface.co/csukuangfj/icefall-asr-librispeech-pruned-transducer-stateless3-2022-05-13>

which supports only English as it is trained on the [LibriSpeech](#) corpus.

You can find the training code at

[https://github.com/k2-fsa/icefall/tree/master/egs/librispeech/ASR/pruned\\_transducer\\_stateless3](https://github.com/k2-fsa/icefall/tree/master/egs/librispeech/ASR/pruned_transducer_stateless3)

In the following, we describe how to download it and use it with `sherpa-onnix`.

## Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
→conformer-en-2023-03-18.tar.bz2

# For Chinese users, you can use the following mirror
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
→conformer-en-2023-03-18.tar.bz2

tar xvf sherpa-onnx-conformer-en-2023-03-18.tar.bz2
rm sherpa-onnx-conformer-en-2023-03-18.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of \*.onnx files below.

```
sherpa-onnx-en-2023-03-18$ ls -lh *.onnx
-rw-r--r-- 1 kuangfangjun root 1.3M Apr 1 07:02 decoder-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 kuangfangjun root 2.0M Apr 1 07:02 decoder-epoch-99-avg-1.onnx
-rw-r--r-- 1 kuangfangjun root 122M Apr 1 07:02 encoder-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 kuangfangjun root 315M Apr 1 07:02 encoder-epoch-99-avg-1.onnx
-rw-r--r-- 1 kuangfangjun root 254K Apr 1 07:02 joiner-epoch-99-avg-1.int8.onnx
-rw-r--r-- 1 kuangfangjun root 1003K Apr 1 07:02 joiner-epoch-99-avg-1.onnx
```

## Decode wave files

---

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

---

### fp32

The following code shows how to use fp32 models to decode wave files:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./sherpa-onnx-conformer-en-2023-03-18/tokens.txt \
--encoder=./sherpa-onnx-conformer-en-2023-03-18/encoder-epoch-99-avg-1.onnx \
--decoder=./sherpa-onnx-conformer-en-2023-03-18/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-conformer-en-2023-03-18/joiner-epoch-99-avg-1.onnx \
./sherpa-onnx-conformer-en-2023-03-18/test_wavs/0.wav \
./sherpa-onnx-conformer-en-2023-03-18/test_wavs/1.wav \
./sherpa-onnx-conformer-en-2023-03-18/test_wavs/8k.wav
```

---

**Note:** Please use ./build/bin/Release/sherpa-onnx-offline.exe for Windows.

---

You should see the following output:

```
OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,
feature_dim=80), model_
config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="./
sherpa-onnx-conformer-en-2023-03-18/encoder-epoch-99-avg-1.onnx", decoder_filename="./
sherpa-onnx-conformer-en-2023-03-18/decoder-epoch-99-avg-1.onnx", joiner_filename="./
sherpa-onnx-conformer-en-2023-03-18/joiner-epoch-99-avg-1.onnx"), paraformer=OfflineParaformerModelConfig(model=""), tokens="./sherpa-onnx-conformer-en-
2023-03-18/tokens.txt", num_threads=2, debug=False), decoding_method="greedy_search")
Creating recognizer ...
2023-04-01 07:11:51.666456713 [E:onnxruntime:, env.cc:251 ThreadMain] pthread_
setaffinity_np failed for thread: 608379, index: 15, mask: {16, 52, }, error code: 22
error msg: Invalid argument. Specify the number of threads explicitly so the affinity
is not set.
2023-04-01 07:11:51.666458525 [E:onnxruntime:, env.cc:251 ThreadMain] pthread_
setaffinity_np failed for thread: 608380, index: 16, mask: {17, 53, }, error code: 22
error msg: Invalid argument. Specify the number of threads explicitly so the affinity
is not set.
```

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```

Started
Creating a resampler:
  in_sample_rate: 8000
  output_sample_rate: 16000

Done!

./sherpa-onnx-conformer-en-2023-03-18/test_wavs/0.wav
AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID_
→ QUARTER OF THE BROTHELS
-----
./sherpa-onnx-conformer-en-2023-03-18/test_wavs/1.wav
GOD AS A DIRECT CONSEQUENCE OF THE SIN WHICH MAN THUS PUNISHED HAD GIVEN HER A LOVELY_
→ CHILD WHOSE PLACE WAS ON THAT SAME DISHONORED BOSOM TO CONNECT HER PARENT FOREVER WITH_
→ THE RACE AND DESCENT OF MORTALS AND TO BE FINALLY A BLESSED SOUL IN HEAVEN
-----
./sherpa-onnx-conformer-en-2023-03-18/test_wavs/8k.wav
YET THESE THOUGHTS AFFECTED HESTER PRYNNE LESS WITH HOPE THAN APPREHENSION
-----
num threads: 2
decoding method: greedy_search
Elapsed seconds: 2.264 s
Real time factor (RTF): 2.264 / 28.165 = 0.080

```

## int8

The following code shows how to use int8 models to decode wave files:

```

cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./sherpa-onnx-conformer-en-2023-03-18/tokens.txt \
--encoder=./sherpa-onnx-conformer-en-2023-03-18/encoder-epoch-99-avg-1.int8.onnx \
--decoder=./sherpa-onnx-conformer-en-2023-03-18/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-conformer-en-2023-03-18/joiner-epoch-99-avg-1.int8.onnx \
./sherpa-onnx-conformer-en-2023-03-18/test_wavs/0.wav \
./sherpa-onnx-conformer-en-2023-03-18/test_wavs/1.wav \
./sherpa-onnx-conformer-en-2023-03-18/test_wavs/8k.wav

```

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

You should see the following output:

```

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,_
→ feature_dim=80), model_\
→ config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="./
→ sherpa-onnx-conformer-en-2023-03-18/encoder-epoch-99-avg-1.int8.onnx", decoder_
→ filename="../sherpa-onnx-conformer-en-2023-03-18/decoder-epoch-99-avg-1.onnx", joiner_
→ filename="../sherpa-onnx-conformer-en-2023-03-18/joiner-epoch-99-avg-1.int8.onnx"),_
→ paraformer=OfflineParaformerModelConfig(model=""), tokens=".sherpa-onnx-conformer-en-
→ 2023-03-18/tokens.txt", num_threads=2, debug=False), decoding_method="greedy_search")

```

(continued from previous page)

```

Creating recognizer ...
2023-04-01 07:13:26.514109433 [E:onnxruntime:, env.cc:251 ThreadMain] pthread_
↳ setaffinity_np failed for thread: 608419, index: 15, mask: {16, 52, }, error code: 22
↳ error msg: Invalid argument. Specify the number of threads explicitly so the affinity
↳ is not set.
2023-04-01 07:13:26.514112711 [E:onnxruntime:, env.cc:251 ThreadMain] pthread_
↳ setaffinity_np failed for thread: 608420, index: 16, mask: {17, 53, }, error code: 22
↳ error msg: Invalid argument. Specify the number of threads explicitly so the affinity
↳ is not set.
Started
Creating a resampler:
  in_sample_rate: 8000
  output_sample_rate: 16000

Done!

./sherpa-onnx-conformer-en-2023-03-18/test_wavs/0.wav
AFTER EARLY NIGHTFALL THE YELLOW LAMPS WOULD LIGHT UP HERE AND THERE THE SQUALID
↳ QUARTER OF THE BROTHELS
-----
./sherpa-onnx-conformer-en-2023-03-18/test_wavs/1.wav
GOD AS A DIRECT CONSEQUENCE OF THE SIN WHICH MAN THUS PUNISHED HAD GIVEN HER A LOVELY
↳ CHILD WHOSE PLACE WAS ON THAT SAME DISHONORED BOSOM TO CONNECT HER PARENT FOREVER WITH
↳ THE RACE AND DESCENT OF MORTALS AND TO BE FINALLY A BLESSED SOUL IN HEAVEN
-----
./sherpa-onnx-conformer-en-2023-03-18/test_wavs/8k.wav
YET THESE THOUGHTS AFFECTED HESTER PRYNNE LESS WITH HOPE THAN APPREHENSION
-----
num threads: 2
decoding method: greedy_search
Elapsed seconds: 1.370 s
Real time factor (RTF): 1.370 / 28.165 = 0.049

```

## Speech recognition from a microphone

```

cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-microphone-offline \
--tokens=./sherpa-onnx-conformer-en-2023-03-18/tokens.txt \
--encoder=./sherpa-onnx-conformer-en-2023-03-18/encoder-epoch-99-avg-1.onnx \
--decoder=./sherpa-onnx-conformer-en-2023-03-18/decoder-epoch-99-avg-1.onnx \
--joiner=./sherpa-onnx-conformer-en-2023-03-18/joiner-epoch-99-avg-1.onnx

```

## 8.22.5 Offline paraformer models

This section lists available offline paraformer models.

### Paraformer models

---

**Hint:** Please refer to [Installation](#) to install `sherpa-onnx` before you read this section.

---

**csukuangfj/sherpa-onnx-paraformer-trilingual-zh-cantonese-en (Chinese + English + Cantonese )**

---

**Note:** This model does not support timestamps. It is a trilingual model, supporting both Chinese and English. ()

---

This model is converted from

[https://www.modelscope.cn/models/dengcunqin/speech\\_seaco\\_paraformer\\_large\\_asr\\_nat-zh-cantonese-en-16k-common-vocab11666-pytorch/summary](https://www.modelscope.cn/models/dengcunqin/speech_seaco_paraformer_large_asr_nat-zh-cantonese-en-16k-common-vocab11666-pytorch/summary)

In the following, we describe how to download it and use it with `sherpa-onnx`.

#### Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
˓→paraformer-trilingual-zh-cantonese-en.tar.bz2

# For Chinese users
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
˓→paraformer-trilingual-zh-cantonese-en.tar.bz2

tar xvf sherpa-onnx-paraformer-trilingual-zh-cantonese-en.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of `*.onnx` files below.

```
sherpa-onnx-paraformer-trilingual-zh-cantonese-en$ ls -lh *.onnx

-rw-r--r-- 1 1001 127 234M Mar 10 02:12 model.int8.onnx
-rw-r--r-- 1 1001 127 831M Mar 10 02:12 model.onnx
```

## Decode wave files

---

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

---

### fp32

The following code shows how to use fp32 models to decode wave files:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./sherpa-onnx-paraformer-trilingual-zh-cantonese-en/tokens.txt \
--paraformer=./sherpa-onnx-paraformer-trilingual-zh-cantonese-en/model.onnx \
./sherpa-onnx-paraformer-trilingual-zh-cantonese-en/test_wavs/1.wav \
./sherpa-onnx-paraformer-trilingual-zh-cantonese-en/test_wavs/2.wav \
./sherpa-onnx-paraformer-trilingual-zh-cantonese-en/test_wavs/3-sichuan.wav \
./sherpa-onnx-paraformer-trilingual-zh-cantonese-en/test_wavs/4-tianjin.wav \
./sherpa-onnx-paraformer-trilingual-zh-cantonese-en/test_wavs/5-henan.wav \
./sherpa-onnx-paraformer-trilingual-zh-cantonese-en/test_wavs/6-zh-en.wav
```

---

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

---

**Caution:** If you use Windows and get encoding issues, please run:

CHCP 65001

in your commandline.

You should see the following output:

```
/project/sherpa-onnx/csrc/parse-options.cc:Read:361 sherpa-onnx-offline --tokens=./
sherpa-onnx-paraformer-trilingual-zh-cantonese-en/tokens.txt --paraformer=./sherpa-
onnx-paraformer-trilingual-zh-cantonese-en/model.onnx ./sherpa-onnx-paraformer-
trilingual-zh-cantonese-en/test_wavs/1.wav ./sherpa-onnx-paraformer-trilingual-zh-
cantonese-en/test_wavs/2.wav ./sherpa-onnx-paraformer-trilingual-zh-cantonese-en/test_
wavs/3-sichuan.wav ./sherpa-onnx-paraformer-trilingual-zh-cantonese-en/test_wavs/4-
tianjin.wav ./sherpa-onnx-paraformer-trilingual-zh-cantonese-en/test_wavs/5-henan.wav .
./sherpa-onnx-paraformer-trilingual-zh-cantonese-en/test_wavs/6-zh-en.wav

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,_
feature_dim=80), model_
config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="",_
decoder_filename="", joiner_filename=""),_
paraformer=OfflineParaformerModelConfig(model="./sherpa-onnx-paraformer-trilingual-zh-
cantonese-en/model.onnx"), nemo_ctc=OfflineNemoEncDecCtcModelConfig(model=""),_
whisper=OfflineWhisperModelConfig(encoder="", decoder="", language="", task="transcribe
", tail_paddings=-1), tdnn=OfflineTdnnModelConfig(model=""), zipformer_
ctc=OfflineZipformerCtcModelConfig(model=""), wenet_ (continues on next page)
ctc=OfflineWenetCtcModelConfig(model=""), tokens="./sherpa-onnx-paraformer-trilingual-
zh-cantonese-en/tokens.txt", num_threads=2, debug=False, provider="cpu", model_type="444
"), lm_config=OfflineLmConfig(model="", scale=0.5), ctc fst_decoder_
config=OfflineCtcFstDecoderConfig(graph="", max_active=3000), decoding_method="greedy_
search", max_active_paths=4, hotwords_file="", hotwords_score=1.5, blank_penalty=0)
```

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**int8**

The following code shows how to use int8 models to decode wave files:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./sherpa-onnx-paraformer-trilingual-zh-cantonese-en/tokens.txt \
--paraformer=./sherpa-onnx-paraformer-trilingual-zh-cantonese-en/model.int8.onnx \
./sherpa-onnx-paraformer-trilingual-zh-cantonese-en/test_wavs/1.wav \
./sherpa-onnx-paraformer-trilingual-zh-cantonese-en/test_wavs/2.wav \
./sherpa-onnx-paraformer-trilingual-zh-cantonese-en/test_wavs/3-sichuan.wav \
./sherpa-onnx-paraformer-trilingual-zh-cantonese-en/test_wavs/4-tianjin.wav \
./sherpa-onnx-paraformer-trilingual-zh-cantonese-en/test_wavs/5-henan.wav \
./sherpa-onnx-paraformer-trilingual-zh-cantonese-en/test_wavs/6-zh-en.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

**Caution:** If you use Windows and get encoding issues, please run:

```
CHCP 65001
```

in your commandline.

You should see the following output:

```
/project/sherpa-onnx/csrc/parse-options.cc:Read:361 sherpa-onnx-offline --tokens=./
sherpa-onnx-paraformer-trilingual-zh-cantonese-en/tokens.txt --paraformer=./sherpa-
onnx-paraformer-trilingual-zh-cantonese-en/model.int8.onnx ./sherpa-onnx-paraformer-
trilingual-zh-cantonese-en/test_wavs/1.wav ./sherpa-onnx-paraformer-trilingual-zh-
cantonese-en/test_wavs/2.wav ./sherpa-onnx-paraformer-trilingual-zh-cantonese-en/test_
wavs/3-sichuan.wav ./sherpa-onnx-paraformer-trilingual-zh-cantonese-en/test_wavs/4-
tianjin.wav ./sherpa-onnx-paraformer-trilingual-zh-cantonese-en/test_wavs/5-henan.wav .
./sherpa-onnx-paraformer-trilingual-zh-cantonese-en/test_wavs/6-zh-en.wav

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,_
feature_dim=80), model_
config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="",_
decoder_filename="", joiner_filename=""),_
paraformer=OfflineParaformerModelConfig(model="./sherpa-onnx-paraformer-trilingual-zh-
cantonese-en/model.int8.onnx"), nemo_ctc=OfflineNemoEncDecCtcModelConfig(model=""),_
whisper=OfflineWhisperModelConfig(encoder="", decoder="", language="", task="transcribe
", tail_paddings=-1), tdnn=OfflineTdnnModelConfig(model=""), zipformer_
ctc=OfflineZipformerCtcModelConfig(model=""), wenet_
ctc=OfflineWenetCtcModelConfig(model=""), tokens="./sherpa-onnx-paraformer-trilingual-
zh-cantonese-en/tokens.txt", num_threads=2, debug=False, provider="cpu", model_type=""),
lm_config=OfflineLMConfig(model="", scale=0.5), ctc_fst_decoder_
config=OfflineCtcFstDecoderConfig(graph="", max_active=3000), decoding_method="greedy_
search", max_active_paths=4, hotwords_file="", hotwords_score=1.5, blank_penalty=0)
Creating recognizer ...
Started
```

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```

/project/sherpa-onnx/csrc/offline-paraformer-greedy-search-decoder.cc:Decode:65 time_
↳ stamp for batch: 0, 13 vs -1
/project/sherpa-onnx/csrc/offline-paraformer-greedy-search-decoder.cc:Decode:65 time_
↳ stamp for batch: 1, 15 vs -1
/project/sherpa-onnx/csrc/offline-paraformer-greedy-search-decoder.cc:Decode:65 time_
↳ stamp for batch: 2, 40 vs -1
/project/sherpa-onnx/csrc/offline-paraformer-greedy-search-decoder.cc:Decode:65 time_
↳ stamp for batch: 3, 41 vs -1
/project/sherpa-onnx/csrc/offline-paraformer-greedy-search-decoder.cc:Decode:65 time_
↳ stamp for batch: 4, 37 vs -1
/project/sherpa-onnx/csrc/offline-paraformer-greedy-search-decoder.cc:Decode:65 time_
↳ stamp for batch: 5, 16 vs -1
Done!

./sherpa-onnx-paraformer-trilingual-zh-cantonese-en/test_wavs/1.wav
{"text": "", "timestamps": [], "tokens":["", "", "", "", "", "", "", "", "", "", "", "", "", "", ""], "tokens":[]}
-----
./sherpa-onnx-paraformer-trilingual-zh-cantonese-en/test_wavs/2.wav
{"text": "", "timestamps": [], "tokens":["", "", "", "", "", "", "", "", "", "", "", "", "", "", ""], "tokens":[]}
-----
./sherpa-onnx-paraformer-trilingual-zh-cantonese-en/test_wavs/3-sichuan.wav
{"text": "", "timestamps": [], "tokens":["", "", "", "", "", "", "", "", "", "", "", "", "", "", "", ""], "tokens":[]}
-----
./sherpa-onnx-paraformer-trilingual-zh-cantonese-en/test_wavs/4-tianjin.wav
{"text": "", "timestamps": [], "tokens":["", "", "", "", "", "", "", "", "", "", "", "", "", "", "", ""], "tokens":[]}
-----
./sherpa-onnx-paraformer-trilingual-zh-cantonese-en/test_wavs/5-henan.wav
{"text": "", "timestamps": [], "tokens":["", "", "", "", "", "", "", "", "", "", "", "", "", "", "", ""], "tokens":[]}
-----
./sherpa-onnx-paraformer-trilingual-zh-cantonese-en/test_wavs/6-zh-en.wav
{"text": " yesterday was today is tuesday ", "timestamps": [], "tokens":["yesterday", "was", "", "", "", "today", "is", "tu@@", "es@@", "day", "", "", "", "", "", ""], "tokens":[]}
-----
num threads: 2
decoding method: greedy_search
Elapsed seconds: 6.290 s
Real time factor (RTF): 6.290 / 42.054 = 0.150

```

## Speech recognition from a microphone

```
cd /path/to/sherpa-onnx
./build/bin/sherpa-onnx-microphone-offline \
--tokens=./sherpa-onnx-parafomer-trilingual-zh-cantonese-en/tokens.txt \
--parafomer=./sherpa-onnx-parafomer-trilingual-zh-cantonese-en/model.int8.onnx
```

[csukuangfj/sherpa-onnx-parafomer-en-2024-03-09 \(English\)](#)

---

**Note:** This model does not support timestamps. It supports only English.

---

This model is converted from

[https://www.modelscope.cn/models/iic/speech\\_parafomer\\_asr-en-16k-vocab4199-pytorch/summary](https://www.modelscope.cn/models/iic/speech_parafomer_asr-en-16k-vocab4199-pytorch/summary)

In the following, we describe how to download it and use it with `sherpa-onnx`.

### Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
˓→parafomer-en-2024-03-09.tar.bz2

# For Chinese users
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
˓→parafomer-en-2024-03-09.tar.bz2

tar xvf sherpa-onnx-parafomer-en-2024-03-09.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of \*.onnx files below.

```
sherpa-onnx-parafomer-en-2024-03-09$ ls -lh *.onnx
-rw-r--r-- 1 1001 127 220M Mar 10 02:12 model.int8.onnx
-rw-r--r-- 1 1001 127 817M Mar 10 02:12 model.onnx
```

### Decode wave files

---

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

---

## fp32

The following code shows how to use fp32 models to decode wave files:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./sherpa-onnx-paraformer-en-2024-03-09/tokens.txt \
--paraformer=./sherpa-onnx-paraformer-en-2024-03-09/model.onnx \
./sherpa-onnx-paraformer-en-2024-03-09/test_wavs/0.wav \
./sherpa-onnx-paraformer-en-2024-03-09/test_wavs/1.wav \
./sherpa-onnx-paraformer-en-2024-03-09/test_wavs/8k.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

You should see the following output:

```
/project/sherpa-onnx/csrc/parse-options.cc:Read:361 sherpa-onnx-offline --tokens=./
sherpa-onnx-paraformer-en-2024-03-09/tokens.txt --paraformer=./sherpa-onnx-paraformer-
en-2024-03-09/model.onnx ./sherpa-onnx-paraformer-en-2024-03-09/test_wavs/0.wav ./
sherpa-onnx-paraformer-en-2024-03-09/test_wavs/1.wav ./sherpa-onnx-paraformer-en-2024-
03-09/test_wavs/8k.wav

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,
feature_dim=80), model_
config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="",
decoder_filename="", joiner_filename=""),
paraformer=OfflineParaformerModelConfig(model="./sherpa-onnx-paraformer-en-2024-03-09/
model.onnx"), nemo_ctc=OfflineNemoEncDecCtcModelConfig(model=""),
whisper=OfflineWhisperModelConfig(encoder="", decoder="", language="", task="transcribe",
tail_paddings=-1), tdnn=OfflineTdnmModelConfig(model=""),
zipformer_ctc=OfflineZipformerCtcModelConfig(model=""),
wenet_ctc=OfflineWenetCtcModelConfig(model=""),
tokens="./sherpa-onnx-paraformer-en-2024-03-09/tokens.txt",
num_threads=2, debug=False, provider="cpu", model_type=""),
lm_config=OfflineLmConfig(model="", scale=0.5),
ctc fst_decoder_config=OfflineCtcFstDecoderConfig(graph="",
max_active=3000), decoding_method="greedy search",
max_active_paths=4, hotwords_file="", hotwords_score=1.5, blank_penalty=0)
Creating recognizer ...
Started
/project/sherpa-onnx/csrc/offline-stream.cc:AcceptWaveformImpl:119 Creating a resampler:
  in_sample_rate: 8000
  output_sample_rate: 16000

Done!

./sherpa-onnx-paraformer-en-2024-03-09/test_wavs/0.wav
{"text": " after early nightfall the yellow lamps would light up here and there the
squalid quarter of the brothels", "timestamps": [], "tokens": ["after", "early", "ni@@", "ght@@", "fall", "the", "yel@@", "low", "la@@", "mp@@", "s", "would", "light", "up", "here", "and", "there", "the", "squ@@", "al@@", "id", "quarter", "of", "the", "bro@@", "the@@", "ls"]}
```

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```
./sherpa-onnx-paraformer-en-2024-03-09/test_wavs/1.wav
{"text": " god as a direct consequence of the sin which man thus punished had given her, a lovely child whose place was 'on' that same dishonoured bosom to connect her parent, for ever with the race and descent of mortals and to be finally a blessed soul in heaven", "timestamps": [], "tokens": ["god", "as", "a", "direct", "con@@", "sequence", "of", "the", "sin", "which", "man", "thus", "p@@", "uni@@", "shed", "had", "given", "her", "a", "lo@@", "vely", "child", "whose", "place", "was", "'on'", "that", "same", "di@@", "sh@@", "on@@", "ou@@", "red", "bo@@", "so@@", "m", "to", "connect", "her", "paren@@", "t", "for", "ever", "with", "the", "race", "and", "des@@", "cent", "of", "mor@@", "tal@@", "s", "and", "to", "be", "finally", "a", "bl@@", "essed", "soul", "in", "hea@@", "ven"]}

---
./sherpa-onnx-paraformer-en-2024-03-09/test_wavs/8k.wav
{"text": " yet these thoughts affected hester prynne less with hope than apprehension", "timestamps": [], "tokens": ["yet", "these", "thoughts", "aff@@", "ected", "he@@", "ster", "pr@@", "y@@", "n@@", "ne", "less", "with", "hope", "than", "ap@@", "pre@@", "hen@@", "sion"]}

---
num threads: 2
decoding method: greedy_search
Elapsed seconds: 7.173 s
Real time factor (RTF): 7.173 / 28.165 = 0.255
```

**int8**

The following code shows how to use `int8` models to decode wave files:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./sherpa-onnx-paraformer-en-2024-03-09/tokens.txt \
--paraformer=./sherpa-onnx-paraformer-en-2024-03-09/model.int8.onnx \
./sherpa-onnx-paraformer-en-2024-03-09/test_wavs/0.wav \
./sherpa-onnx-paraformer-en-2024-03-09/test_wavs/1.wav \
./sherpa-onnx-paraformer-en-2024-03-09/test_wavs/8k.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

You should see the following output:

```
/project/sherpa-onnx/csrc/parse-options.cc:Read:361 sherpa-onnx-offline --tokens=./
sherpa-onnx-paraformer-en-2024-03-09/tokens.txt --paraformer=./sherpa-onnx-paraformer-
en-2024-03-09/model.int8.onnx ./sherpa-onnx-paraformer-en-2024-03-09/test_wavs/0.wav ./
sherpa-onnx-paraformer-en-2024-03-09/test_wavs/1.wav ./sherpa-onnx-paraformer-en-2024-
03-09/test_wavs/8k.wav

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,
feature_dim=80), model_
config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="",
decoder_filename="", joiner_filename=""),
paraformer=OfflineParaformerModelConfig(model="./sherpa-onnx-paraformer-en-2024-03-09/
model.int8.onnx"), nemo_ctc=OfflineNemoEncDecCtcModelConfig(model=""),
450 whisper=OfflineWhisperModelConfig(encoder="", decoder="", language="", task="transcribe",
tail_paddings=-1), tdn=OfflineTdnModelConfig(model=""), zipformer_
ctc=OfflineZipformerCtcModelConfig(model=""), wenet_
ctc=OfflineWenetCtcModelConfig(model=""), tokens="./sherpa-onnx-paraformer-en-2024-03-
09/tokens.txt", num_threads=2, debug=False, provider="cpu", model_type=""), lm
```

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```

Creating recognizer ...
Started
/project/sherpa-onnx/csrc/offline-stream.cc:AcceptWaveformImpl:119 Creating a resampler:
  in_sample_rate: 8000
  output_sample_rate: 16000

Done!

./sherpa-onnx-paraformer-en-2024-03-09/test_wavs/0.wav
{"text": " after early nightfall the yellow lamps would light up here and there the
  ↵ squalid quarter of the brothels", "timestamps": [], "tokens": ["after", "early", "ni@@",
  ↵ "ght@@", "fall", "the", "yel@@", "low", "la@@", "mp@@", "s", "would", "light", "up",
  ↵ "here", "and", "there", "the", "squ@@", "al@@", "id", "quarter", "of", "the", "bro@@",
  ↵ "the@@", "ls"]}

---
./sherpa-onnx-paraformer-en-2024-03-09/test_wavs/1.wav
{"text": " god as a direct consequence of the sin which man thus punished had given her
  ↵ a lovely child whose place was 'on' that same dishonoured bosom to connect her parent
  ↵ for ever with the race and descent of mortals and to be finally a blessed soul in
  ↵ heaven", "timestamps": [], "tokens": ["god", "as", "a", "direct", "con@@", "sequence",
  ↵ "of", "the", "sin", "which", "man", "thus", "p@@", "uni@@", "shed", "had", "given",
  ↵ "her", "a", "lo@@", "vely", "child", "whose", "place", "was", "'on'", "that", "same",
  ↵ "di@@", "sh@@", "on@@", "ou@@", "red", "bo@@", "so@@", "m", "to", "connect", "her",
  ↵ "paren@@", "t", "for", "ever", "with", "the", "race", "and", "des@@", "cent", "of",
  ↵ "mor@@", "tal@@", "s", "and", "to", "be", "finally", "a", "bl@@", "essed", "soul", "in
  ↵ ", "hea@@", "ven"]}

---
./sherpa-onnx-paraformer-en-2024-03-09/test_wavs/8k.wav
{"text": " yet these thoughts affected hester prynne less with hope than apprehension",
  "timestamps": [], "tokens": ["yet", "these", "thoughts", "aff@@", "ected", "he@@", "ster",
  ↵ ", "pr@@", "y@@", "n@@", "ne", "less", "with", "hope", "than", "ap@@", "pre@@", "hen@@",
  ↵ ", "sion"]}

---
num threads: 2
decoding method: greedy_search
Elapsed seconds: 5.492 s
Real time factor (RTF): 5.492 / 28.165 = 0.195

```

## Speech recognition from a microphone

```

cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-microphone-offline \
  --tokens=./sherpa-onnx-paraformer-en-2024-03-09/tokens.txt \
  --paraformer=./sherpa-onnx-paraformer-en-2024-03-09/model.int8.onnx

```

## csukuangfj/sherpa-onnx-parafomer-zh-small-2024-03-09 (Chinese + English)

---

**Note:** This model does not support timestamps. It is a bilingual model, supporting both Chinese and English. ()

---

This model is converted from

[https://www.modelscope.cn/models/crazyant/speech\\_parafomer\\_asr\\_nat-zh-cn-16k-common-vocab8358-onnx/summary](https://www.modelscope.cn/models/crazyant/speech_parafomer_asr_nat-zh-cn-16k-common-vocab8358-onnx/summary)

In the following, we describe how to download it and use it with `sherpa-onnx`.

### Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
˓→parafomer-zh-small-2024-03-09.tar.bz2

# For Chinese users
wget https://hub.nuua.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
˓→parafomer-zh-small-2024-03-09.tar.bz2

tar xvf sherpa-onnx-parafomer-zh-small-2024-03-09.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of `*.onnx` files below.

```
sherpa-onnx-parafomer-zh-small-2024-03-09$ ls -lh *.onnx
-rw-r--r-- 1 1001 127 79M Mar 10 00:48 model.int8.onnx
```

### Decode wave files

---

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

---

#### int8

The following code shows how to use `int8` models to decode wave files:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./sherpa-onnx-parafomer-zh-small-2024-03-09/tokens.txt \
--parafomer=./sherpa-onnx-parafomer-zh-small-2024-03-09/model.int8.onnx \
./sherpa-onnx-parafomer-zh-small-2024-03-09/test_wavs/0.wav \
./sherpa-onnx-parafomer-zh-small-2024-03-09/test_wavs/1.wav \
```

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```
./sherpa-onnx-paraformer-zh-small-2024-03-09/test_wavs/8k.wav \
./sherpa-onnx-paraformer-zh-small-2024-03-09/test_wavs/2-zh-en.wav \
./sherpa-onnx-paraformer-zh-small-2024-03-09/test_wavs/3-sichuan.wav \
./sherpa-onnx-paraformer-zh-small-2024-03-09/test_wavs/4-tianjin.wav \
./sherpa-onnx-paraformer-zh-small-2024-03-09/test_wavs/5-henan.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

**Caution:** If you use Windows and get encoding issues, please run:

CHCP 65001

in your commandline.

You should see the following output:

```
/project/sherpa-onnx/csrc/parse-options.cc:Read:361 sherpa-onnx-offline --tokens=./  
→sherpa-onnx-paraformer-zh-small-2024-03-09/tokens.txt --paraformer=./sherpa-onnx-  
→paraformer-zh-small-2024-03-09/model.int8.onnx ./sherpa-onnx-paraformer-zh-small-2024-  
→03-09/test_wavs/0.wav ./sherpa-onnx-paraformer-zh-small-2024-03-09/test_wavs/1.wav ./  
→sherpa-onnx-paraformer-zh-small-2024-03-09/test_wavs/8k.wav ./sherpa-onnx-paraformer-  
→zh-small-2024-03-09/test_wavs/2-zh-en.wav ./sherpa-onnx-paraformer-zh-small-2024-03-09/  
→test_wavs/3-sichuan.wav ./sherpa-onnx-paraformer-zh-small-2024-03-09/test_wavs/4-  
→tianjin.wav ./sherpa-onnx-paraformer-zh-small-2024-03-09/test_wavs/5-henan.wav  
  
OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,  
→feature_dim=80), model_=  
→config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="",  
→decoder_filename="", joiner_filename=""),  
→paraformer=OfflineParaformerModelConfig(model="./sherpa-onnx-paraformer-zh-small-2024-  
→03-09/model.int8.onnx"), nemo_ctc=OfflineNemoEncDecCtcModelConfig(model=""),  
→whisper=OfflineWhisperModelConfig(encoder="", decoder="", language="", task="transcribe",  
→tail_paddings=-1), tdnn=OfflineTdnnModelConfig(model=""), zipformer_=  
→ctc=OfflineZipformerCtcModelConfig(model=""), wenet_=  
→ctc=OfflineWenetCtcModelConfig(model=""), tokens="./sherpa-onnx-paraformer-zh-small-  
→2024-03-09/tokens.txt", num_threads=2, debug=False, provider="cpu", model_type=""), lm_=  
→config=OfflineLMConfig(model="", scale=0.5), ctc_fst_decoder_=  
→config=OfflineCtcFstDecoderConfig(graph="", max_active=3000), decoding_method="greedy_  
→search", max_active_paths=4, hotwords_file="", hotwords_score=1.5, blank_penalty=0)  
Creating recognizer ...  
Started  
/project/sherpa-onnx/csrc/offline-stream.cc:AcceptWaveformImpl:119 Creating a resampler:  
    in_sample_rate: 8000  
    output_sample_rate: 16000
```

Done!

./sherpa-onnéx-paraformer-zh-small-2024-03-09/test\_ways/0.wav

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## Speech recognition from a microphone

```
cd /path/to/sherpa-onnx  
  
./build/bin/sherpa-onnéx-microphone-offline \  
--tokens=./sherpa-onnéx-paraformer-zh-small-2024-03-09/tokens.txt \  
--paraformer=./sherpa-onnéx-paraformer-zh-small-2024-03-09/model.int8.onnéx
```

## csukuangfj/sherpa-onnx-parafomer-zh-2024-03-09 (Chinese + English)

**Note:** This model does not support timestamps. It is a bilingual model, supporting both Chinese and English. ()

This model is converted from

[https://www.modelscope.cn/models/crazyant/speech\\_parafomer\\_asr\\_nat-zh-cn-16k-common-vocab8358-onnx/summary](https://www.modelscope.cn/models/crazyant/speech_parafomer_asr_nat-zh-cn-16k-common-vocab8358-onnx/summary)

In the following, we describe how to download it and use it with `sherpa-onnx`.

### Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
˓→parafomer-zh-2024-03-09.tar.bz2

# For Chinese users
# wget https://hub.nuua.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
˓→parafomer-zh-2024-03-09.tar.bz2

tar xvf sherpa-onnx-parafomer-zh-2024-03-09.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of `*.onnx` files below.

```
sherpa-onnx-parafomer-zh-2024-03-09$ ls -lh *.onnx
-rw-r--r-- 1 1001 127 217M Mar 10 02:22 model.int8.onnx
-rw-r--r-- 1 1001 127 785M Mar 10 02:22 model.onnx
```

### Decode wave files

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

### fp32

The following code shows how to use `fp32` models to decode wave files:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./sherpa-onnx-parafomer-zh-2024-03-09/tokens.txt \
--parafomer=./sherpa-onnx-parafomer-zh-2024-03-09/model.onnx \
./sherpa-onnx-parafomer-zh-2024-03-09/test_wavs/0.wav \
```

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```
./sherpa-onnx-paraformer-zh-2024-03-09/test_wavs/1.wav \
./sherpa-onnx-paraformer-zh-2024-03-09/test_wavs/8k.wav \
./sherpa-onnx-paraformer-zh-2024-03-09/test_wavs/2-zh-en.wav \
./sherpa-onnx-paraformer-zh-2024-03-09/test_wavs/3-sichuan.wav \
./sherpa-onnx-paraformer-zh-2024-03-09/test_wavs/4-tianjin.wav \
./sherpa-onnx-paraformer-zh-2024-03-09/test_wavs/5-henan.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

**Caution:** If you use Windows and get encoding issues, please run:

`CHCP 65001`

in your commandline.

You should see the following output:

```
/project/sherpa-onnx/csrc/parse-options.cc:Read:361 sherpa-onnx-offline --tokens=./
sherpa-onnx-paraformer-zh-2024-03-09/tokens.txt --paraformer=./sherpa-onnx-paraformer-
zh-2024-03-09/model.onnx ./sherpa-onnx-paraformer-zh-2024-03-09/test_wavs/0.wav ./
sherpa-onnx-paraformer-zh-2024-03-09/test_wavs/1.wav ./sherpa-onnx-paraformer-zh-2024-
03-09/test_wavs/8k.wav ./sherpa-onnx-paraformer-zh-2024-03-09/test_wavs/2-zh-en.wav ./
sherpa-onnx-paraformer-zh-2024-03-09/test_wavs/3-sichuan.wav ./sherpa-onnx-paraformer-
zh-2024-03-09/test_wavs/4-tianjin.wav ./sherpa-onnx-paraformer-zh-2024-03-09/test_wavs/
5-henan.wav

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,_
feature_dim=80), model_
config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="",_
decoder_filename="", joiner_filename=""),_
paraformer=OfflineParaformerModelConfig(model="./sherpa-onnx-paraformer-zh-2024-03-09/
model.onnx"), nemo_ctc=OfflineNemoEncDecCtcModelConfig(model=""),_
whisper=OfflineWhisperModelConfig(encoder="", decoder="", language="", task="transcribe
", tail_paddings=-1), tdnn=OfflineTdnnModelConfig(model=""), zipformer_
ctc=OfflineZipformerCtcModelConfig(model=""), wenet_
ctc=OfflineWenetCtcModelConfig(model=""), tokens="./sherpa-onnx-paraformer-zh-2024-03-
09/tokens.txt", num_threads=2, debug=False, provider="cpu", model_type=""), lm_
config=OfflineLMConfig(model="", scale=0.5), ctc_fst_decoder_
config=OfflineCtcFstDecoderConfig(graph="", max_active=3000), decoding_method="greedy_
search", max_active_paths=4, hotwords_file="", hotwords_score=1.5, blank_penalty=0)
Creating recognizer ...
Started
/project/sherpa-onnx/csrc/offline-stream.cc:AcceptWaveformImpl:119 Creating a resampler:
  in_sample_rate: 8000
  output_sample_rate: 16000

Done!
./sherpa-onnx-paraformer-zh-2024-03-09/test_wavs/0.wav
```

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int8

The following code shows how to use `int8` models to decode wave files:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnéx-offline \
--tokens=./sherpa-onnéx-paraformer-zh-2024-03-09/tokens.txt \
--paraformer=./sherpa-onnéx-paraformer-zh-2024-03-09/model.int8.onnéx \
./sherpa-onnéx-paraformer-zh-2024-03-09/test_wavs/0.wav \
./sherpa-onnéx-paraformer-zh-2024-03-09/test_wavs/1.wav \
./sherpa-onnéx-paraformer-zh-2024-03-09/test_wavs/8k.wav \
./sherpa-onnéx-paraformer-zh-2024-03-09/test_wavs/2-zh-en.wav \
./sherpa-onnéx-paraformer-zh-2024-03-09/test_wavs/3-sichuan.wav \
./sherpa-onnéx-paraformer-zh-2024-03-09/test_wavs/4-tianjin.wav
```

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./sherpa-onnéx-paraformer-zh-2024-03-09/test\_wavs/5-henan.wav

**Note:** Please use `./build/bin/Release/sherpa-ONNX-offline.exe` for Windows.

**Caution:** If you use Windows and get encoding issues, please run:

CHCP 65001

in your commandline.

You should see the following output:

```
/project/sherpa-onnx/csrc/parse-options.cc:Read:361 sherpa-onnx-offline --tokens=./  
sherpa-onnx-paraformer-zh-2024-03-09/tokens.txt --paraformer=./sherpa-onnx-paraformer-  
zh-2024-03-09/model.onnx ./sherpa-onnx-paraformer-zh-2024-03-09/test_wavs/0.wav ./  
sherpa-onnx-paraformer-zh-2024-03-09/test_wavs/1.wav ./sherpa-onnx-paraformer-zh-2024-  
03-09/test_wavs/8k.wav ./sherpa-onnx-paraformer-zh-2024-03-09/test_wavs/2-zh-en.wav ./  
sherpa-onnx-paraformer-zh-2024-03-09/test_wavs/3-sichuan.wav ./sherpa-onnx-paraformer-  
zh-2024-03-09/test_wavs/4-tianjin.wav ./sherpa-onnx-paraformer-zh-2024-03-09/test_wavs/  
5-henan.wav
```

```
OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000, ↴
↳ feature_dim=80), model_ ↴
↳ config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="", ↴
↳ decoder_filename="", joiner_filename=""), ↴
↳ paraformer=OfflineParaformerModelConfig(model=".sherpa-ONNX-paraformer-zh-2024-03-09/ ↴
↳ model.onnx"), nemo_ctc=OfflineNemoEncDecCtcModelConfig(model=""), ↴
↳ whisper=OfflineWhisperModelConfig(encoder="", decoder="", language="", task="transcribe", ↴
↳ tail_paddings=-1), tdnn=OfflineTdnmModelConfig(model=""), zipformer_ ↴
↳ ctc=OfflineZipformerCtcModelConfig(model=""), wenet_ ↴
↳ ctc=OfflineWenetCtcModelConfig(model=""), tokens=".sherpa-ONNX-paraformer-zh-2024-03- ↴
↳ 09/tokens.txt", num_threads=2, debug=False, provider="cpu", model_type=""), lm_ ↴
↳ config=OfflineLmConfig(model="", scale=0.5), ctc_fst_decoder_ ↴
↳ config=OfflineCtcFstDecoderConfig(graph="", max_active=3000), decoding_method="greedy_ ↴
↳ search", max_active_paths=4, hotwords_file="", hotwords_score=1.5, blank_penalty=0)
```

## Creating recognizer ...

Started

```
[...]  
/project/sherpa-ONNX/cs/src/offline-stream.cc:AcceptWaveformImpl:119 Creating a resampler:  
  in_sample_rate: 8000  
  output sample rate: 16000
```

Done!

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## Speech recognition from a microphone

```
cd /path/to/sherpa-onnx
./build/bin/sherpa-onnx-microphone-offline \
--tokens=./sherpa-onnx-paraformer-zh-2024-03-09/tokens.txt \
--paraformer=./sherpa-onnx-paraformer-zh-2024-03-09/model.int8.onnx
```

csukuangfj/sherpa-onnéx-parformer-zh-2023-03-28 (Chinese + English)

**Note:** This model does not support timestamps. It is a bilingual model, supporting both Chinese and English. ()

This model is converted from

[https://www.modelscope.cn/models/damo/speech\\_paraformer-large\\_asr\\_nat-zh-cn-16k-common-vocab8404-pytorch](https://www.modelscope.cn/models/damo/speech_paraformer-large_asr_nat-zh-cn-16k-common-vocab8404-pytorch)

The code for converting can be found at

<https://huggingface.co/csukuangfj/paraformer-onnxruntime-python-example/tree/main>

In the following, we describe how to download it and use it with `sherpa-onnx`.

### Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
˓→paraformer-zh-2023-03-28.tar.bz2

# For Chinese users
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
˓→paraformer-zh-2023-03-28.tar.bz2

tar xvf sherpa-onnx-paraformer-zh-2023-03-28.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of `*.onnx` files below.

```
sherpa-onnx-paraformer-zh-2023-03-28$ ls -lh *.onnx
-rw-r--r-- 1 kuangfangjun root 214M Apr  1 07:28 model.int8.onnx
-rw-r--r-- 1 kuangfangjun root 824M Apr  1 07:28 model.onnx
```

### Decode wave files

---

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

---

#### fp32

The following code shows how to use `fp32` models to decode wave files:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./sherpa-onnx-paraformer-zh-2023-03-28/tokens.txt \
--paraformer=./sherpa-onnx-paraformer-zh-2023-03-28/model.onnx \
./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/0.wav \
./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/1.wav \
./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/2.wav \
./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/3-sichuan.wav \
./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/4-tianjin.wav \
./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/5-henan.wav \
./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/6-zh-en.wav \
./sherpa-onnx-paraformer-zh-2023-03-28/test_wavs/8k.wav
```

---

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

---

**Caution:** If you use Windows and get encoding issues, please run:

CHCP 65001

in your commandline.

You should see the following output:

(continued from previous page)

int8

The following code shows how to use `int8` models to decode wave files:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnéx-offline \
--tokens=./sherpa-onnéx-paraformer-zh-2023-03-28/tokens.txt \
--paraformer=./sherpa-onnéx-paraformer-zh-2023-03-28/model.int8.onnéx \
./sherpa-onnéx-paraformer-zh-2023-03-28/test_wavs/0.wav \
./sherpa-onnéx-paraformer-zh-2023-03-28/test_wavs/1.wav \
./sherpa-onnéx-paraformer-zh-2023-03-28/test_wavs/2.wav \
./sherpa-onnéx-paraformer-zh-2023-03-28/test_wavs/3-sichuan.wav \
./sherpa-onnéx-paraformer-zh-2023-03-28/test_wavs/4-tianjin.wav \
./sherpa-onnéx-paraformer-zh-2023-03-28/test_wavs/5-henan.wav \
./sherpa-onnéx-paraformer-zh-2023-03-28/test_wavs/6-zh-en.wav \
./sherpa-onnéx-paraformer-zh-2023-03-28/test_wavs/8k.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

**Caution:** If you use Windows and get encoding issues, please run:

CHCP 65001

in your commandline.

You should see the following output:

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## Speech recognition from a microphone

```
cd /path/to/sherpa-onnx
./build/bin/sherpa-onnéx-microphone-offline \
--tokens=./sherpa-onnéx-paraformer-zh-2023-03-28/tokens.txt \
--paraformer=./sherpa-onnéx-paraformer-zh-2023-03-28/model.int8.onnéx
```

csukuangfj/sherpa-onnéx-parformer-zh-2023-09-14 (Chinese + English)

**Note:** This model supports timestamps. It is a bilingual model, supporting both Chinese and English. ()

This model is converted from

[https://www.modelscope.cn/models/iic/speech\\_paraformer-large-vad-punc\\_asr\\_nat-zh-cn-16k-common-vocab8404-onnx/summary](https://www.modelscope.cn/models/iic/speech_paraformer-large-vad-punc_asr_nat-zh-cn-16k-common-vocab8404-onnx/summary)

In the following, we describe how to download it and use it with `sherpa-onnix`.

## Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
˓→paraformer-zh-2023-09-14.tar.bz2

# For Chinese users
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
˓→paraformer-zh-2023-09-14.tar.bz2

tar xvf sherpa-onnx-paraformer-zh-2023-09-14.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of \*.onnx files below.

```
sherpa-onnx-paraformer-zh-2023-09-14$ ls -lh *.onnx
-rw-r--r-- 1 fangjun staff 232M Sep 14 13:46 model.int8.onnx
```

## Decode wave files

---

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

---

### int8

The following code shows how to use int8 models to decode wave files:

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./sherpa-onnx-paraformer-zh-2023-09-14/tokens.txt \
--paraformer=./sherpa-onnx-paraformer-zh-2023-09-14/model.int8.onnx \
--model-type=paraformer \
./sherpa-onnx-paraformer-zh-2023-09-14/test_wavs/0.wav \
./sherpa-onnx-paraformer-zh-2023-09-14/test_wavs/1.wav \
./sherpa-onnx-paraformer-zh-2023-09-14/test_wavs/2.wav \
./sherpa-onnx-paraformer-zh-2023-09-14/test_wavs/3-sichuan.wav \
./sherpa-onnx-paraformer-zh-2023-09-14/test_wavs/4-tianjin.wav \
./sherpa-onnx-paraformer-zh-2023-09-14/test_wavs/5-henan.wav \
./sherpa-onnx-paraformer-zh-2023-09-14/test_wavs/6-zh-en.wav \
./sherpa-onnx-paraformer-zh-2023-09-14/test_wavs/8k.wav
```

---

**Note:** Please use ./build/bin/Release/sherpa-onnx-offline.exe for Windows.

---

**Caution:** If you use Windows and get encoding issues, please run:

```
CHCP 65001
```

in your commandline.

You should see the following output:

```
/project/sherpa-onnx/csrc/parse-options.cc:Read:361 sherpa-onnx-offline --tokens=./  
sherpa-onnx-paraformer-zh-2023-09-14/tokens.txt --paraformer=./sherpa-onnx-paraformer-  
zh-2023-09-14/model.int8.onnx --model-type=paraformer ./sherpa-onnx-paraformer-zh-2023-  
09-14/test_wavs/0.wav ./sherpa-onnx-paraformer-zh-2023-09-14/test_wavs/1.wav ./sherpa-  
onnx-paraformer-zh-2023-09-14/test_wavs/2.wav ./sherpa-onnx-paraformer-zh-2023-09-14/  
test_wavs/3-sichuan.wav ./sherpa-onnx-paraformer-zh-2023-09-14/test_wavs/4-tianjin.wav  
./sherpa-onnx-paraformer-zh-2023-09-14/test_wavs/5-henan.wav ./sherpa-onnx-paraformer-  
zh-2023-09-14/test_wavs/6-zh-en.wav ./sherpa-onnx-paraformer-zh-2023-09-14/test_wavs/  
8k.wav  
  
OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,  
feature_dim=80), model_  
config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="",  
decoder_filename="", joiner_filename=""),  
paraformer=OfflineParaformerModelConfig(model="./sherpa-onnx-paraformer-zh-2023-09-14/  
model.int8.onnx"), nemo_ctc=OfflineNemoEncDecCtcModelConfig(model=""),  
whisper=OfflineWhisperModelConfig(encoder="", decoder="", language="", task="transcribe",  
tail_paddings=-1), tdnr=OfflineTdnrModelConfig(model=""), zipformer_  
ctc=OfflineZipformerCtcModelConfig(model=""), wenet_  
ctc=OfflineWenetCtcModelConfig(model=""), tokens="./sherpa-onnx-paraformer-zh-2023-09-  
14/tokens.txt", num_threads=2, debug=False, provider="cpu", model_type="paraformer"),  
lm_config=OfflineLMConfig(model="", scale=0.5), ctc_fst_decoder_  
config=OfflineCtcFstDecoderConfig(graph="", max_active=3000), decoding_method="greedy_  
search", max_active_paths=4, hotwords_file="", hotwords_score=1.5, blank_penalty=0)  
Creating recognizer ...  
Started  
/project/sherpa-onnx/csrc/offline-stream.cc:AcceptWaveformImpl:119 Creating a resampler:  
    in_sample_rate: 8000  
    output_sample_rate: 16000  
  
Done!  
  
.sherpa-onnx-paraformer-zh-2023-09-14/test_wavs/0.wav  
{"text": "", "timestamps": [0.36, 0.48, 0.62, 0.72, 0.86, 1.02, 1.32, 1.74, 1.90, 2.12,  
2.20, 2.38, 2.50, 2.62, 2.74, 3.18, 3.32, 3.52, 3.62, 3.74, 3.82, 3.90, 3.98, 4.08, 4.  
20, 4.34, 4.56, 4.74, 5.10], "tokens": ["", "", "", "", "", "", "", "", "", "", "",  
 "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", ""]}  
---  
.sherpa-onnx-paraformer-zh-2023-09-14/test_wavs/1.wav  
{"text": "", "timestamps": [0.16, 0.30, 0.42, 0.56, 0.72, 0.96, 1.08, 1.20, 1.30, 2.08,  
2.26, 2.44, 2.58, 2.72, 2.98, 3.14, 3.26, 3.46, 3.62, 3.80, 3.88, 4.02, 4.12, 4.20, 4.  
36, 4.56], "tokens": ["", "", "", "", "", "", "", "", "", "", "", "", "", "", "", "", ""]}  
---  
.sherpa-onnx-paraformer-zh-2023-09-14/test_wavs/2.wav
```

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## Speech recognition from a microphone

```
cd /path/to/sherpa-onnx
./build/bin/sherpa-onnx-microphone-offline \
--tokens=./sherpa-onnx-paraformer-zh-2023-09-14/tokens.txt \
--paraformer=./sherpa-onnx-paraformer-zh-2023-09-14/model.int8.onnx \
--model-type=paraformer
```

## 8.22.6 Offline CTC models

This section lists available offline CTC models.

### NeMo

This page lists all offline CTC models from NeMo.

---

**Hint:** Please refer to [https://catalog.ngc.nvidia.com/orgs/nvidia/collections/nemo\\_asr](https://catalog.ngc.nvidia.com/orgs/nvidia/collections/nemo_asr) for a list of pre-trained NeMo models.

---

### How to export models from NeMo to sherpa-onnx

This section describes how to export CTC models from NeMo to `sherpa-onnx`.

---

**Hint:** Please refer to [https://catalog.ngc.nvidia.com/orgs/nvidia/collections/nemo\\_asr](https://catalog.ngc.nvidia.com/orgs/nvidia/collections/nemo_asr) for a list of pre-trained NeMo models.

---

You can use method described in this section to convert more models to `sherpa-onnx`.

---

Let us take the following model as an example:

[https://ngc.nvidia.com/models/nvidia:nemo:stt\\_en\\_conformer\\_ctc\\_small](https://ngc.nvidia.com/models/nvidia:nemo:stt_en_conformer_ctc_small).

---

**Hint:** You can find the exported files in this example by visiting

<https://huggingface.co/csukuangfj/sherpa-onnx-nemo-ctc-en-conformer-small>

---

The steps to export it to `sherpa-onnx` are given below.

## Step 1: Export model.onnx

The first step is to obtain `model.onnx`.

```
import nemo.collections.asr as nemo_asr
m = nemo_asr.models.EncDecCTCModelBPE.from_pretrained('stt_en_conformer_ctc_small')
m.export('model.onnx')
```

## Step 2: Add metadata

To be usable in `sherpa-onnx`, we have to use `add-model-metadata.py` to add metadata to `model.onnx`.

```
wget https://huggingface.co/csukuangfj/sherpa-onnx-nemo-ctc-en-conformer-small/resolve/
└─main/add-model-metadata.py

# The following command changes model.onnx in-place
python3 add-model-metadata.py
```

## Step 3: Obtain model.int8.onnx

We can use `quantize-model.py` to obtain a quantized version of `model.onnx`:

```
wget https://huggingface.co/csukuangfj/sherpa-onnx-nemo-ctc-en-conformer-small/resolve/
└─main/quantize-model.py

# The following command will generate model.int8.onnx
python3 ./quantize-model.py
```

## Step 4: Obtain tokens.txt

Use the following command to obtain `tokens.txt`:

```
import nemo.collections.asr as nemo_asr
m = nemo_asr.models.EncDecCTCModelBPE.from_pretrained('stt_en_conformer_ctc_small')

with open('tokens.txt', 'w') as f:
    for i, s in enumerate(m.decoder.vocabulary):
        f.write(f'{s} {i}\n')
        f.write(f'<blk> {i+1}\n')
```

## English

---

**Hint:** Please refer to [Installation](#) to install `sherpa-onnx` before you read this section.

---

**Note:** We use `./build/bin/sherpa-offline` as an example in this section. You can use other scripts such as

- `./build/bin/sherpa-onnx-microphone-offline`
  - `./build/bin/sherpa-onnx-offline-websocket-server`
  - `python-api-examples/offline-decode-files.py`
- 

This page lists offline CTC models from NeMo for English.

### **stt\_en\_citrinet\_512**

This model is converted from

[https://catalog.ngc.nvidia.com/orgs/nvidia/teams/nemo/models/stt\\_en\\_citrinet\\_512](https://catalog.ngc.nvidia.com/orgs/nvidia/teams/nemo/models/stt_en_citrinet_512)

Citrinet-512 model which has been trained on the ASR Set dataset with over 7000 hours of english speech.

In the following, we describe how to download it and use it with `sherpa-onnx`.

#### **Download the model**

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-nemo-
      ↪ctc-en-citrinet-512.tar.bz2

# For Chinese users, please use the following mirror
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
      ↪nemo-ctc-en-citrinet-512.tar.bz2

tar xvf sherpa-onnx-nemo-ctc-en-citrinet-512.tar.bz2
rm sherpa-onnx-nemo-ctc-en-citrinet-512.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of `*.onnx` files below.

```
sherpa-onnx-nemo-ctc-en-citrinet-512 fangjun$ ls -lh *.onnx
-rw-r--r-- 1 fangjun staff 36M Apr  7 16:10 model.int8.onnx
-rw-r--r-- 1 fangjun staff 142M Apr  7 14:24 model.onnx
```

## Decode wave files

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

The following code shows how to use fp32 models to decode wave files. Please replace `model.onnx` with `model.int8.onnx` to use int8 quantized model.

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./sherpa-onnx-nemo-ctc-en-citrinet-512/tokens.txt \
--nemo-ctc-model=./sherpa-onnx-nemo-ctc-en-citrinet-512/model.onnx \
--num-threads=2 \
--decoding-method=greedy_search \
--debug=false \
./sherpa-onnx-nemo-ctc-en-citrinet-512/test_wavs/0.wav \
./sherpa-onnx-nemo-ctc-en-citrinet-512/test_wavs/1.wav \
./sherpa-onnx-nemo-ctc-en-citrinet-512/test_wavs/8k.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./
↳ build/bin/sherpa-onnx-offline --tokens=./sherpa-onnx-nemo-ctc-en-citrinet-512/tokens.
↳ txt --nemo-ctc-model=./sherpa-onnx-nemo-ctc-en-citrinet-512/model.onnx --num-threads=2
↳ --decoding-method=greedy_search --debug=false ./sherpa-onnx-nemo-ctc-en-citrinet-512/
↳ test_wavs/0.wav ./sherpa-onnx-nemo-ctc-en-citrinet-512/test_wavs/1.wav ./sherpa-onnx-
↳ nemo-ctc-en-citrinet-512/test_wavs/8k.wav

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,
↳ feature_dim=80), model_
↳ config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="",
↳ decoder_filename="", joiner_filename=""),
↳ paraformer=OfflineParaformerModelConfig(model=""), nemo_
↳ ctc=OfflineNemoEncDecCtcModelConfig(model="./sherpa-onnx-nemo-ctc-en-citrinet-512/
↳ model.onnx"), tokens="./sherpa-onnx-nemo-ctc-en-citrinet-512/tokens.txt", num_
↳ threads=2, debug=False), decoding_method="greedy_search")
Creating recognizer ...
Started
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/offline-stream.
↳ cc:AcceptWaveformImpl:105 Creating a resampler:
    in_sample_rate: 8000
    output_sample_rate: 16000

Done!

./sherpa-onnx-nemo-ctc-en-citrinet-512/test_wavs/0.wav
after early nightfall the yellow lamps would light up here and there the squalid
↳ quarter of the brothels
```

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```
-----
./sherpa-onnx-nemo-ctc-en-citrinet-512/test_wavs/1.wav
god as a direct consequence of the sin which man thus punished had given her a lovely_
child whose place was on that same dishonoured bosom to connect her parent for ever_
with the race and descent of mortals and to be finally a blessed soul in heaven
-----
./sherpa-onnx-nemo-ctc-en-citrinet-512/test_wavs/8k.wav
yet these thoughts affected hester prynne less with hope than apprehension
-----
num threads: 2
decoding method: greedy_search
Elapsed seconds: 4.963 s
Real time factor (RTF): 4.963 / 28.165 = 0.176
```

## **stt\_en\_conformer\_ctc\_small**

This model is converted from

[https://registry.ngc.nvidia.com/orgs/nvidia/teams/nemo/models/stt\\_en\\_conformer\\_ctc\\_small](https://registry.ngc.nvidia.com/orgs/nvidia/teams/nemo/models/stt_en_conformer_ctc_small)

It contains small size versions of Conformer-CTC (13M parameters) trained on NeMo ASRSet with around 16000 hours of english speech. The model transcribes speech in lower case english alphabet along with spaces and apostrophes.

In the following, we describe how to download it and use it with `sherpa-onnx`.

### **Download the model**

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-nemo-
ctc-en-conformer-small.tar.bz2

# For Chinese users, please use the following mirror
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
nemo-ctc-en-conformer-small.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of \*.onnx files below.

```
sherpa-onnx-nemo-ctc-en-conformer-small fangjun$ ls -lh *.onnx
-rw-r--r-- 1 fangjun staff 44M Apr  7 20:24 model.int8.onnx
-rw-r--r-- 1 fangjun staff 81M Apr  7 18:56 model.onnx
```

## Decode wave files

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

The following code shows how to use fp32 models to decode wave files. Please replace `model.onnx` with `model.int8.onnx` to use int8 quantized model.

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./sherpa-onnx-nemo-ctc-en-conformer-small/tokens.txt \
--nemo-ctc-model=./sherpa-onnx-nemo-ctc-en-conformer-small/model.onnx \
--num-threads=2 \
--decoding-method=greedy_search \
--debug=false \
./sherpa-onnx-nemo-ctc-en-conformer-small/test_wavs/0.wav \
./sherpa-onnx-nemo-ctc-en-conformer-small/test_wavs/1.wav \
./sherpa-onnx-nemo-ctc-en-conformer-small/test_wavs/8k.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./
~/build/bin/sherpa-onnx-offline --tokens=./sherpa-onnx-nemo-ctc-en-conformer-small/
~/tokens.txt --nemo-ctc-model=./sherpa-onnx-nemo-ctc-en-conformer-small/model.onnx --num-
~/threads=2 --decoding-method=greedy_search --debug=false ./sherpa-onnx-nemo-ctc-en-
~/conformer-small/test_wavs/0.wav ./sherpa-onnx-nemo-ctc-en-conformer-small/test_wavs/1.
~/wav ./sherpa-onnx-nemo-ctc-en-conformer-small/test_wavs/8k.wav

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,_
~/feature_dim=80), model_
~/config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="",_
~/decoder_filename="", joiner_filename=""),_
~/paraformer=OfflineParaformerModelConfig(model=""), nemo_
~/ctc=OfflineNemoEncDecCtcModelConfig(model="./sherpa-onnx-nemo-ctc-en-conformer-small/
~/model.onnx"), tokens="./sherpa-onnx-nemo-ctc-en-conformer-small/tokens.txt", num_
~/threads=2, debug=False), decoding_method="greedy_search")
Creating recognizer ...
Started
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/offline-stream.
~/cc:AcceptWaveformImpl:105 Creating a resampler:
  in_sample_rate: 8000
  output_sample_rate: 16000

Done!

./sherpa-onnx-nemo-ctc-en-conformer-small/test_wavs/0.wav
after early nightfall the yellow lamps would light up here and there the squalid_
~/quarter of the brothels
```

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```
----  
./sherpa-onnx-nemo-ctc-en-conformer-small/test_wavs/1.wav  
god as a direct consequence of the sin which man thus punished had given her a lovely  
child whose place was on that same dishonoured bosom to connect her parent for ever  
with the race and descent of mortals and to be finally a blessed soul in heaven  
----  
./sherpa-onnx-nemo-ctc-en-conformer-small/test_wavs/8k.wav  
yet these thoughts affected hester prin less with hope than apprehension  
----  
num threads: 2  
decoding method: greedy_search  
Elapsed seconds: 0.665 s  
Real time factor (RTF): 0.665 / 28.165 = 0.024
```

## **stt\_en\_conformer\_ctc\_medium**

This model is converted from

[https://registry.ngc.nvidia.com/orgs/nvidia/teams/nemo/models/stt\\_en\\_conformer\\_ctc\\_medium](https://registry.ngc.nvidia.com/orgs/nvidia/teams/nemo/models/stt_en_conformer_ctc_medium)

It contains medium size versions of Conformer-CTC (around 30M parameters) trained on NeMo ASRSet with around 16000 hours of english speech. The model transcribes speech in lower case english alphabet along with spaces and apostrophes.

In the following, we describe how to download it and use it with `sherpa-onnx`.

### **Download the model**

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx  
  
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-nemo-  
-ctc-en-conformer-medium.tar.bz2  
  
# For Chinese users, please use the following mirror  
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-  
-nemo-ctc-en-conformer-medium.tar.bz2  
  
tar xvf sherpa-onnx-nemo-ctc-en-conformer-medium.tar.bz2  
rm sherpa-onnx-nemo-ctc-en-conformer-medium.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of \*.onnx files below.

```
sherpa-onnx-nemo-ctc-en-conformer-medium fangjun$ ls -lh *.onnx  
-rw-r--r-- 1 fangjun staff 64M Apr  7 20:44 model.int8.onnx  
-rw-r--r-- 1 fangjun staff 152M Apr  7 20:43 model.onnx
```

## Decode wave files

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

The following code shows how to use fp32 models to decode wave files. Please replace `model.onnx` with `model.int8.onnx` to use int8 quantized model.

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./sherpa-onnx-nemo-ctc-en-conformer-medium/tokens.txt \
--nemo-ctc-model=./sherpa-onnx-nemo-ctc-en-conformer-medium/model.onnx \
--num-threads=2 \
--decoding-method=greedy_search \
--debug=false \
./sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/0.wav \
./sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/1.wav \
./sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/8k.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./
build/bin/sherpa-onnx-offline --tokens=./sherpa-onnx-nemo-ctc-en-conformer-medium/
tokens.txt --nemo-ctc-model=./sherpa-onnx-nemo-ctc-en-conformer-medium/model.onnx --
num-threads=2 --decoding-method=greedy_search --debug=false ./sherpa-onnx-nemo-ctc-en-
conformer-medium/test_wavs/0.wav ./sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/
1.wav ./sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/8k.wav

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,_
feature_dim=80), model_
config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="",_
decoder_filename="", joiner_filename=""),_
paraformer=OfflineParaformerModelConfig(model=""), nemo_
ctc=OfflineNemoEncDecCtcModelConfig(model="./sherpa-onnx-nemo-ctc-en-conformer-medium/
model.onnx"), tokens="./sherpa-onnx-nemo-ctc-en-conformer-medium/tokens.txt", num_
threads=2, debug=False), decoding_method="greedy_search")
Creating recognizer ...
Started
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/offline-stream.
cc:AcceptWaveformImpl:105 Creating a resampler:
  in_sample_rate: 8000
  output_sample_rate: 16000

Done!

./sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/0.wav
after early nightfall the yellow lamps would light up here and there the squalid_
quarter of the brothels
```

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```
----  
./sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/1.wav  
god as a direct consequence of the sin which man thus punished had given her a lovely  
→ child whose place was on that same dishonored bosom to connect her parent for ever  
→ with the race and descent of mortals and to be finally a blessed soul in heaven  
----  
./sherpa-onnx-nemo-ctc-en-conformer-medium/test_wavs/8k.wav  
yet these thoughts affected hester pryne less with hope than apprehension  
----  
num threads: 2  
decoding method: greedy_search  
Elapsed seconds: 1.184 s  
Real time factor (RTF): 1.184 / 28.165 = 0.042
```

## stt\_en\_conformer\_ctc\_large

This model is converted from

[https://registry.ngc.nvidia.com/orgs/nvidia/teams/nemo/models/stt\\_en\\_conformer\\_ctc\\_large](https://registry.ngc.nvidia.com/orgs/nvidia/teams/nemo/models/stt_en_conformer_ctc_large)

It contains large size versions of Conformer-CTC (around 120M parameters) trained on NeMo ASRSet with around 24500 hours of english speech. The model transcribes speech in lower case english alphabet along with spaces and apostrophes

In the following, we describe how to download it and use it with `sherpa-onnx`.

### Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx  
  
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-nemo-  
→ ctc-en-conformer-large.tar.bz2  
  
# For Chinese users, please use the following mirror  
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-  
→ nemo-ctc-en-conformer-large.tar.bz2  
  
tar xvf sherpa-onnx-nemo-ctc-en-conformer-large.tar.bz2  
rm sherpa-onnx-nemo-ctc-en-conformer-large.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of \*.onnx files below.

```
sherpa-onnx-nemo-ctc-en-conformer-large fangjun$ ls -lh *.onnx  
-rw-r--r-- 1 fangjun staff 162M Apr  7 22:01 model.int8.onnx  
-rw-r--r-- 1 fangjun staff 508M Apr  7 22:01 model.onnx
```

## Decode wave files

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

The following code shows how to use fp32 models to decode wave files. Please replace `model.onnx` with `model.int8.onnx` to use int8 quantized model.

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--tokens=./sherpa-onnx-nemo-ctc-en-conformer-large/tokens.txt \
--nemo-ctc-model=./sherpa-onnx-nemo-ctc-en-conformer-large/model.onnx \
--num-threads=2 \
--decoding-method=greedy_search \
--debug=false \
./sherpa-onnx-nemo-ctc-en-conformer-large/test_wavs/0.wav \
./sherpa-onnx-nemo-ctc-en-conformer-large/test_wavs/1.wav \
./sherpa-onnx-nemo-ctc-en-conformer-large/test_wavs/8k.wav
```

**Note:** Please use `./build/bin/Release/sherpa-onnx-offline.exe` for Windows.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./
~/build/bin/sherpa-onnx-offline --tokens=./sherpa-onnx-nemo-ctc-en-conformer-large/
~/tokens.txt --nemo-ctc-model=./sherpa-onnx-nemo-ctc-en-conformer-large/model.onnx --num-
~/threads=2 --decoding-method=greedy_search --debug=false ./sherpa-onnx-nemo-ctc-en-
~/conformer-large/test_wavs/0.wav ./sherpa-onnx-nemo-ctc-en-conformer-large/test_wavs/1.
~/wav ./sherpa-onnx-nemo-ctc-en-conformer-large/test_wavs/8k.wav

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,_
~/feature_dim=80), model_
~/config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="",_
~/decoder_filename="", joiner_filename=""),_
~/paraformer=OfflineParaformerModelConfig(model=""), nemo_
~/ctc=OfflineNemoEncDecCtcModelConfig(model="./sherpa-onnx-nemo-ctc-en-conformer-large/
~/model.onnx"), tokens="./sherpa-onnx-nemo-ctc-en-conformer-large/tokens.txt", num_
~/threads=2, debug=False), decoding_method="greedy_search")
Creating recognizer ...
Started
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/offline-stream.
~/cc:AcceptWaveformImpl:105 Creating a resampler:
  in_sample_rate: 8000
  output_sample_rate: 16000

Done!

./sherpa-onnx-nemo-ctc-en-conformer-large/test_wavs/0.wav
after early nightfall the yellow lamps would light up here and there the squalid_
~/quarter of the brothels
```

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(continued from previous page)

```
----  
./sherpa-onnx-nemo-ctc-en-conformer-large/test_wavs/1.wav  
god as a direct consequence of the sin which man thus punished had given her a lovely  
→ child whose place was on that same dishonored bosom to connect her parent for ever  
→ with the race and descent of mortals and to be finally a blesed soul in heaven  
----  
./sherpa-onnx-nemo-ctc-en-conformer-large/test_wavs/8k.wav  
yet these thoughts afected hester pryne les with hope than apprehension  
----  
num threads: 2  
decoding method: greedy_search  
Elapsed seconds: 3.553 s  
Real time factor (RTF): 3.553 / 28.165 = 0.126
```

## yesno

This section describes how to use the `tdnn` model of the `yesno` dataset from `icefall` in `sherpa-onnx`.

---

**Note:** It is a **non-streaming** model and it can only recognize two words in `Hebrew`: `yes` and `no`.

---

To download the model, please use:

```
cd /path/to/sherpa-onnx  
  
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-tdnn-  
→yesno.tar.bz2  
  
# For Chinese users, please use the following mirror  
# wget https://hub.nuaa.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-  
→tdnn-yesno.tar.bz2  
  
tar xvf sherpa-onnx-tdnn-yesno.tar.bz2  
rm sherpa-onnx-tdnn-yesno.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of `*.onnx` files below.

```
sherpa-onnx-tdnn-yesno fangjun$ ls -lh *.onnx  
-rw-r--r-- 1 fangjun staff 55K Aug 12 17:02 model-epoch-14-avg-2.int8.onnx  
-rw-r--r-- 1 fangjun staff 54K Aug 12 17:02 model-epoch-14-avg-2.onnx
```

## Decode wave files

---

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

---

The following code shows how to use `fp32` models to decode wave files. Please replace `model-epoch-14-avg-2.int8.onnx` with `model-epoch-14-avg-2.int8.onnx` to use the `int8` quantized model.

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--sample-rate=8000 \
--feat-dim=23 \
--tokens=./sherpa-onnx-tdnn-yesno/tokens.txt \
--tdnn-model=./sherpa-onnx-tdnn-yesno/model-epoch-14-avg-2.onnx \
./sherpa-onnx-tdnn-yesno/test_wavs/0_0_0_1_0_0_0_1.wav \
./sherpa-onnx-tdnn-yesno/test_wavs/0_0_1_0_0_0_1_0.wav \
./sherpa-onnx-tdnn-yesno/test_wavs/0_0_1_0_0_1_1_1.wav \
./sherpa-onnx-tdnn-yesno/test_wavs/0_0_1_0_1_0_0_1.wav \
./sherpa-onnx-tdnn-yesno/test_wavs/0_0_1_1_0_0_0_1.wav \
./sherpa-onnx-tdnn-yesno/test_wavs/0_0_1_1_0_1_1_0.wav
```

The output is given below:

```
OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=8000,
→feature_dim=23), model_
→config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="",
→decoder_filename="", joiner_filename=""),
→paraformer=OfflineParaformerModelConfig(model=""),
→nemo_
→ctc=OfflineNemoEncDecCtcModelConfig(model=""),
→whisper=OfflineWhisperModelConfig(encoder="", decoder=""),
→tdnn=OfflineTdnnModelConfig(model="./sherpa-onnx-tdnn-yesno/model-epoch-14-avg-2.onnx
→"),
→tokens="./sherpa-onnx-tdnn-yesno/tokens.txt", num_threads=2, debug=False, provider=
→"cpu", model_type=""),
→lm_config=OfflineLMConfig(model="", scale=0.5), decoding_method=
→"greedy_search", max_active_paths=4, context_score=1.5)
Creating recognizer ...
Started
Done!

./sherpa-onnx-tdnn-yesno/test_wavs/0_0_0_1_0_0_0_1.wav
{"text": "NNNNNNNN", "timestamps": "[]", "tokens": ["N", "N", "N", "Y", "N", "N", "N", "Y"]}
---
./sherpa-onnx-tdnn-yesno/test_wavs/0_0_1_0_0_0_1_0.wav
{"text": "NNNNNNYN", "timestamps": "[]", "tokens": ["N", "N", "Y", "N", "N", "N", "Y", "N"]}
---
./sherpa-onnx-tdnn-yesno/test_wavs/0_0_1_0_0_1_1_1.wav
{"text": "NNYNNYYY", "timestamps": "[]", "tokens": ["N", "N", "Y", "N", "N", "Y", "Y"]}
---
./sherpa-onnx-tdnn-yesno/test_wavs/0_0_1_0_1_0_1.wav
{"text": "NNYNYNYY", "timestamps": "[]", "tokens": ["N", "N", "Y", "N", "Y", "N", "Y"]}
---
./sherpa-onnx-tdnn-yesno/test_wavs/0_0_1_1_0_0_1.wav
{"text": "NNYYNNNY", "timestamps": "[]", "tokens": ["N", "N", "Y", "Y", "N", "N", "Y"]}
---
./sherpa-onnx-tdnn-yesno/test_wavs/0_0_1_1_0_0_0_1.wav
{"text": "NNYYNYYN", "timestamps": "[]", "tokens": ["N", "N", "Y", "Y", "N", "Y", "N"]}
---
num threads: 2
decoding method: greedy_search
Elapsed seconds: 0.071 s
Real time factor (RTF): 0.071 / 38.530 = 0.002
```

---

**Note:** In the above output, N represents NO, while Y is YES. So for the last wave, NNYYNYYN means NO NO YES YES NO YES YES NO.

In the filename of the last wave `0_0_1_1_0_1_1_0.wav`, 0 means NO and 1 means YES. So the ground truth of the last wave is NO NO YES YES NO YES YES NO.

---

## 8.22.7 TeleSpeech

This page lists all offline CTC models from <https://github.com/Tele-AI/TeleSpeech-ASR>.

---

**Hint:** Please see the license at [TeleSpeech.pdf](#)

Models from <https://github.com/Tele-AI/TeleSpeech-ASR> are subject to the above license if you want to use them for commercial purpose.

---

### How to export models from Tele-AI/TeleSpeech-ASR to sherpa-onnx

This section describes how to export CTC models from *Tele-AI/TeleSpeech-ASR* to `sherpa-onnx`.

#### Step 1: Export `model.onnx`

The first step is to obtain `model.onnx`.

Please see [https://github.com/lovemefan/telespeech-asr-python/blob/main/telespeechasr/onnx/onnx\\_export.py](https://github.com/lovemefan/telespeech-asr-python/blob/main/telespeechasr/onnx/onnx_export.py) for details.

#### Step 2: Add metadata

To be usable in `sherpa-onnx`, we have to use `add-metadata.py` to add metadata to `model.onnx`.

Please see <https://github.com/k2-fsa/sherpa-onnx/blob/master/scripts/tele-speech/run.sh> for details.

#### Step 3: Obtain `tokens.txt`

Please also see <https://github.com/k2-fsa/sherpa-onnx/blob/master/scripts/tele-speech/add-metadata.py>

### Models

#### **sherpa-onnx-telespeech-ctc-int8-zh-2024-06-04 ()**

---

**Hint:**

---

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
↪ telespeech-ctc-int8-zh-2024-06-04.tar.bz2

# For Chinese users, please use the following mirror
# wget https://hub.nuua.cf/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
↪ telespeech-ctc-int8-zh-2024-06-04.tar.bz2

tar xvf sherpa-onnx-telespeech-ctc-int8-zh-2024-06-04.tar.bz2
rm sherpa-onnx-telespeech-ctc-int8-zh-2024-06-04.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of \*.onnx files below.

```
$ ls -lh *.onnx
-rw-r--r-- 1 fangjun  staff  325M Jun  4 11:56 model.int8.onnx
```

## Decode wave files

**Hint:** It supports decoding only wave files of a single channel with 16-bit encoded samples, while the sampling rate does not need to be 16 kHz.

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--telespeech-ctc=./sherpa-onnx-telespeech-ctc-int8-zh-2024-06-04/model.int8.onnx \
--tokens=./sherpa-onnx-telespeech-ctc-int8-zh-2024-06-04/tokens.txt \
--model-type=telespeech_ctc \
--num-threads=1 \
./sherpa-onnx-telespeech-ctc-int8-zh-2024-06-04/test_wavs/3-sichuan.wav \
./sherpa-onnx-telespeech-ctc-int8-zh-2024-06-04/test_wavs/4-tianjin.wav \
./sherpa-onnx-telespeech-ctc-int8-zh-2024-06-04/test_wavs/5-henan.wav
```

**Note:** Please use ./build/bin/Release/sherpa-onnx-offline.exe for Windows.

**Caution:** If you use Windows and get encoding issues, please run:

CHCP 65001

in your commandline.

You should see the following output:

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./
↪ build/bin/sherpa-onnx-offline --telespeech-ctc=./sherpa-onnx-telespeech-ctc-int8-zh-
↪ 2024-06-04/model.int8.onnx --tokens=./sherpa-onnx-telespeech-ctc-int8-zh-2024-06-04/
↪ tokens.txt --model-type=telespeech_ctc --num-threads=1 ./sherpa-onnx-telespeech-ctc-
↪ int8-zh-2024-06-04/test_wavs/3-sichuan.wav ./sherpa-onnx-telespeech-ctc-int8-zh-2024-
↪ 06-04/test_wavs/4-tianjin.wav ./sherpa-onnx-telespeech-ctc-int8-zh-2024-06-04/test_
↪ wavs/5-henan.wav
```

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**Note:** The feature\_dim=80 is incorrect in the above logs. The actual value is 40.

**Hint:** There is also a float32 model. Please see <https://github.com/k2-fsa/sherpa-onnx/releases/download/>

---

asr-models/sherpa-onnx-telespeech-ctc-zh-2024-06-04.tar.bz2

---

## 8.22.8 Whisper

This section describes how to use models from [Whisper](#) with [sherpa-onnx](#) for non-streaming speech recognition.

### Export Whisper to ONNX

This section describes how to export [Whisper](#) models to [onnx](#).

#### Available models

Note that we have already exported [Whisper](#) models to [onnx](#) and they are available from the following [huggingface](#) repositories:

Model type	Huggingface repo
<code>tiny.en</code>	<a href="https://huggingface.co/csukuangfj/sherpa-onnx-whisper-tiny.en">https://huggingface.co/csukuangfj/sherpa-onnx-whisper-tiny.en</a>
<code>base.en</code>	<a href="https://huggingface.co/csukuangfj/sherpa-onnx-whisper-base.en">https://huggingface.co/csukuangfj/sherpa-onnx-whisper-base.en</a>
<code>small.en</code>	<a href="https://huggingface.co/csukuangfj/sherpa-onnx-whisper-small.en">https://huggingface.co/csukuangfj/sherpa-onnx-whisper-small.en</a>
<code>distil-small.en</code>	<a href="https://huggingface.co/csukuangfj/sherpa-onnx-whisper-distil-small.en">https://huggingface.co/csukuangfj/sherpa-onnx-whisper-distil-small.en</a>
<code>medium.en</code>	<a href="https://huggingface.co/csukuangfj/sherpa-onnx-whisper-medium.en">https://huggingface.co/csukuangfj/sherpa-onnx-whisper-medium.en</a>
<code>distil-medium.en</code>	<a href="https://huggingface.co/csukuangfj/sherpa-onnx-whisper-distil-medium.en">https://huggingface.co/csukuangfj/sherpa-onnx-whisper-distil-medium.en</a>
<code>tiny</code>	<a href="https://huggingface.co/csukuangfj/sherpa-onnx-whisper-tiny">https://huggingface.co/csukuangfj/sherpa-onnx-whisper-tiny</a>
<code>base</code>	<a href="https://huggingface.co/csukuangfj/sherpa-onnx-whisper-base">https://huggingface.co/csukuangfj/sherpa-onnx-whisper-base</a>
<code>small</code>	<a href="https://huggingface.co/csukuangfj/sherpa-onnx-whisper-small">https://huggingface.co/csukuangfj/sherpa-onnx-whisper-small</a>
<code>medium</code>	<a href="https://huggingface.co/csukuangfj/sherpa-onnx-whisper-medium">https://huggingface.co/csukuangfj/sherpa-onnx-whisper-medium</a>

---

**Hint:** You can also download them from

<https://github.com/k2-fsa/sherpa-onnx/releases/tag/asr-models>

---

If you want to export the models by yourself or/and want to learn how the models are exported, please read below.

### Export to onnx

We use

<https://github.com/k2-fsa/sherpa-onnx/blob/master/scripts/whisper/export-onnx.py>

to export [Whisper](#) models to [onnx](#).

First, let us install dependencies and download the export script

```
pip install torch openai-whisper onnxruntime onnx

git clone https://github.com/k2-fsa/sherpa-onnx/
cd sherpa-onnx/scripts/whisper
python3 ./export-onnx.py --help
```

It will print the following message:

```
usage: export-onnx.py [-h] --model {tiny,tiny.en,base,base.en,small,small.en,medium,
                     ↵medium.en,large,large-v1,large-v2}

optional arguments:
  -h, --help            show this help message and exit
  --model {tiny,tiny.en,base,base.en,small,small.en,medium,medium.en,large,large-v1,
           ↵large-v2}
```

To export `tiny.en`, we can use:

```
python3 ./export-onnx.py --model tiny.en
```

It will generate the following files:

```
(py38) fangjuns-MacBook-Pro:whisper fangjun$ ls -lh tiny.en-*
-rw-r--r-- 1 fangjun staff 105M Aug 7 15:43 tiny.en-decoder.int8.onnx
-rw-r--r-- 1 fangjun staff 185M Aug 7 15:43 tiny.en-decoder.onnx
-rw-r--r-- 1 fangjun staff 12M Aug 7 15:43 tiny.en-encoder.int8.onnx
-rw-r--r-- 1 fangjun staff 36M Aug 7 15:43 tiny.en-encoder.onnx
-rw-r--r-- 1 fangjun staff 816K Aug 7 15:43 tiny.en-tokens.txt
```

`tiny.en-encoder.onnx` is the encoder model and `tiny.en-decoder.onnx` is the decoder model.

`tiny.en-encoder.int8.onnx` is the quantized encoder model and `tiny.en-decoder.onnx` is the quantized decoder model.

`tiny.en-tokens.txt` contains the token table, which maps an integer to a token and vice versa.

To convert the exported `onnx` model to `onnxruntime` format, we can use

```
python3 -m onnxruntime.tools.convert_onnx_models_to_ort --optimization_style=Fixed ./
```

Now the generated files so far are as follows:

```
(py38) fangjuns-MacBook-Pro:whisper fangjun$ ls -lh tiny.en-*
-rw-r--r-- 1 fangjun staff 105M Aug 7 15:43 tiny.en-decoder.int8.onnx
-rw-r--r-- 1 fangjun staff 185M Aug 7 15:43 tiny.en-decoder.onnx
-rw-r--r-- 1 fangjun staff 12M Aug 7 15:43 tiny.en-encoder.int8.onnx
-rw-r--r-- 1 fangjun staff 36M Aug 7 15:43 tiny.en-encoder.onnx
-rw-r--r-- 1 fangjun staff 816K Aug 7 15:43 tiny.en-tokens.txt
```

**To check whether the exported model works correctly, we can use**

<https://github.com/k2-fsa/sherpa-onnx/blob/master/scripts/whisper/test.py>

We use [https://huggingface.co/csukuangfj/sherpa-onnx-whisper-tiny.en/resolve/main/test\\_wavs/0.wav](https://huggingface.co/csukuangfj/sherpa-onnx-whisper-tiny.en/resolve/main/test_wavs/0.wav) as the test wave.

```
pip install kaldinative-fbank
wget https://huggingface.co/csukuangfj/sherpa-onnx-whisper-tiny.en/resolve/main/test_
↪wavs/0.wav

python3 ./test.py \
  --encoder ./tiny.en-encoder.onnx \
  --decoder ./tiny.en-decoder.onnx \
```

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```
--tokens ./tiny.en-tokens.txt \
./0.wav
```

To test `int8` quantized models, we can use:

```
python3 ./test.py \
--encoder ./tiny.en-encoder.int8.onnx \
--decoder ./tiny.en-decoder.int8.onnx \
--tokens ./tiny.en-tokens.txt \
./0.wav
```

## tiny.en

You can use the following command to download the exported `onnx` models of `tiny.en`:

**Hint:** Please replace `tiny.en` with `base.en`, `small.en`, or `medium.en` if you want to try a different type of model.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/asr-models/sherpa-onnx-
↪whisper-tiny.en.tar.bz2
tar xvf sherpa-onnx-whisper-tiny.en.tar.bz2
```

Please check that the file sizes of the downloaded models are correct. See the file size of `*.onnx` files below.

```
(py38) fangjuns-MacBook-Pro:sherpa-onnx-whisper-tiny.en fangjun$ ls -lh *.onnx
-rw-r--r-- 1 fangjun staff 105M Aug 7 16:22 tiny.en-decoder.int8.onnx
-rw-r--r-- 1 fangjun staff 185M Aug 7 16:23 tiny.en-decoder.onnx
-rw-r--r-- 1 fangjun staff 12M Aug 7 16:22 tiny.en-encoder.int8.onnx
-rw-r--r-- 1 fangjun staff 36M Aug 7 16:22 tiny.en-encoder.onnx
```

To use the downloaded files to decode waves, please run:

**Hint:** Please first follow [Installation](#) to build `sherpa-onnx` before you continue.

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline \
--whisper-encoder=./sherpa-onnx-whisper-tiny.en/tiny.en-encoder.onnx \
--whisper-decoder=./sherpa-onnx-whisper-tiny.en/tiny.en-decoder.onnx \
--tokens=./sherpa-onnx-whisper-tiny.en/tiny.en-tokens.txt \
./sherpa-onnx-whisper-tiny.en/test_wavs/0.wav \
./sherpa-onnx-whisper-tiny.en/test_wavs/1.wav \
./sherpa-onnx-whisper-tiny.en/test_wavs/8k.wav
```

To use `int8` quantized models, please use:

```
cd /path/to/sherpa-onnx
```

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```
./build/bin/sherpa-onnx-offline \
--whisper-encoder=./sherpa-onnx-whisper-tiny.en/tiny.en-encoder.int8.onnx \
--whisper-decoder=./sherpa-onnx-whisper-tiny.en/tiny.en-decoder.int8.onnx \
--tokens=./sherpa-onnx-whisper-tiny.en/tiny.en-tokens.txt \
./sherpa-onnx-whisper-tiny.en/test_wavs/0.wav \
./sherpa-onnx-whisper-tiny.en/test_wavs/1.wav \
./sherpa-onnx-whisper-tiny.en/test_wavs/8k.wav
```

## Real-time factor (RTF) on Raspberry Pi 4 Model B

One of the test command is given below:

```
./sherpa-onnx-offline \
--num-threads=1 \
--whisper-encoder=./sherpa-onnx-whisper-tiny.en/tiny.en-encoder.onnx \
--whisper-decoder=./sherpa-onnx-whisper-tiny.en/tiny.en-decoder.onnx \
--tokens=./sherpa-onnx-whisper-tiny.en/tiny.en-tokens.txt \
./sherpa-onnx-whisper-tiny.en/test_wavs/1.wav
```

And its output is:

```
/root/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/parse-options.cc:Read:361 ./
sherpa-onnx-offline --num-threads=1 --whisper-encoder=./sherpa-onnx-whisper-tiny.en/
tiny.en-encoder.onnx --whisper-decoder=./sherpa-onnx-whisper-tiny.en/tiny.en-decoder.
onnx --tokens=./sherpa-onnx-whisper-tiny.en/tiny.en-tokens.txt ./sherpa-onnx-whisper-
tiny.en/test_wavs/1.wav

OfflineRecognizerConfig(feat_config=OfflineFeatureExtractorConfig(sampling_rate=16000,
feature_dim=80), model_
config=OfflineModelConfig(transducer=OfflineTransducerModelConfig(encoder_filename="",
decoder_filename="", joiner_filename=""),
paraformer=OfflineParaformerModelConfig(model=""),
nemo_
ctc=OfflineNemoEncDecCtcModelConfig(model=""),
whisper=OfflineWhisperModelConfig(encoder="./sherpa-onnx-whisper-tiny.en/tiny.en-
encoder.onnx", decoder="./sherpa-onnx-whisper-tiny.en/tiny.en-decoder.onnx"), tokens="",
./sherpa-onnx-whisper-tiny.en/tiny.en-tokens.txt", num_threads=1, debug=False, provider=
"cpu", model_type=""), lm_config=OfflineLMConfig(model="", scale=0.5), decoding_method=
"greedy_search", max_active_paths=4, context_score=1.5)
Creating recognizer ...
Started
Done!

./sherpa-onnx-whisper-tiny.en/test_wavs/1.wav
{"text":" God, as a direct consequence of the sin which man thus punished, had given her,
a lovely child, whose place was on that same dishonored bosom to connect her parent,
forever with the race and descent of mortals, and to be finally a blessed soul in,
heaven.", "timestamps": "[]", "tokens": [" God", "", " as", " a", " direct", " consequence", " of",
" the", " sin", " which", " man", " thus", " punished", " had", " given", " her", " a",
" lovely", " child", " whose", " place", " was", " on", " that", " same", " dishon", " ored",
" bos", " om", " to", " connect", " her", " parent", " forever", " with", " the", " race", " and",
" descent", " of", " mortals", " and", " to", " be", " finally", " a", " blessed", " soul",
" in", " heaven", "."]}
```

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```
----  
num threads: 1  
decoding method: greedy_search  
Elapsed seconds: 11.454 s  
Real time factor (RTF): 11.454 / 16.715 = 0.685
```

The following table compares the RTF between different number of threads and types of `onnx` models:

Model type	Number of threads	RTF
float32	1	0.685
float32	2	0.559
float32	3	0.526
float32	4	0.520
int8	1	0.547
int8	2	0.431
int8	3	0.398
int8	4	0.386

## colab

We provide a colab notebook for you to try `Whisper` models with `sherpa-onnx` step by step.

This screenshot shows a GitHub Colab notebook titled "sherpa\_onnx\_whisper\_models.ipynb". The notebook is part of the "colab / sherpa-onnx" repository. The introduction section states: "This colab notebook shows how to use [sherpa-onnx](#) to run [whisper](#) models." It lists real-time factors (RTF) for different model types and configurations. The table is as follows:

model	CPU or CUDA	RTF
float32 tiny.en	CPU	0.208
float32 tiny.en	CUDA	0.186
int8 tiny.en	CPU	0.142
int8 tiny.en	CUDA	0.146
float32 base.en	CPU	0.430
float32 base.en	CUDA	0.129
int8 base.en	CPU	0.332
int8 base.en	CUDA	0.259
float32 small.en	CPU	1.633
float32 small.en	CUDA	0.268

## Huggingface space

You can try [Whisper](#) models from within your browser without installing anything.

Please visit

<https://huggingface.co/spaces/k2-fsa/automatic-speech-recognition>

Language

English (selected)

Select a model

whisper-base.en (selected)

Decoding method

greedy\_search (selected)

Number of active paths for modified\_beam\_search

Upload from disk

Record from microphone

From URL

Submit for recognition

Recognized speech from uploaded file

after early nightfall the yellow lamps would light up here and there the squalid quarter of the brothels.

## 8.22.9 WeNet

This page lists all CTC models from WeNet.

### How to export models from WeNet to sherpa-onnx

Suppose you have the following files from WeNet:

- final.pt
- train.yaml
- global\_cmvn
- units.txt

We describe below how to use scripts from `sherpa-onnx` to export your files.

---

**Hint:** Both streaming and non-streaming models are supported.

---

## Export for non-streaming inference

You can use the following script

<https://github.com/k2-fsa/sherpa-onnx/blob/master/scripts/wenet/export-onnx.py>

to export your model to `sherpa-onnx`. After running it, you should get two files:

- `model.onnx`
- `model.int8.onnx`.

Next, we rename `units.txt` to `tokens.txt` to follow the convention used in `sherpa-onnx`:

```
mv units.txt tokens.txt
```

Now you can use the following command for speech recognition with the exported models:

```
# with float32 models
./build/bin/sherpa-onnx-offline \
--wenet-ctc-model=./model.onnx
--tokens=./tokens.txt \
/path/to/some.wav

# with int8 models
./build/bin/sherpa-onnx-offline \
--wenet-ctc-model=./model.int8.onnx
--tokens=./tokens.txt \
/path/to/some.wav
```

## Export for streaming inference

You can use the following script

<https://github.com/k2-fsa/sherpa-onnx/blob/master/scripts/wenet/export-onnx-streaming.py>

to export your model to `sherpa-onnx`. After running it, you should get two files:

- `model-streaming.onnx`
- `model-streaming.int8.onnx`.

Next, we rename `units.txt` to `tokens.txt` to follow the convention used in `sherpa-onnx`:

```
mv units.txt tokens.txt
```

Now you can use the following command for speech recognition with the exported models:

```
# with float32 models
./build/bin/sherpa-onnx \
--wenet-ctc-model=./model-streaming.onnx
--tokens=./tokens.txt \
```

(continues on next page)

(continued from previous page)

```
/path/to/some.wav

# with int8 models
./build/bin/sherpa-onnx \
--wenet-ctc-model=./model-streaming.int8.onnx
--tokens=./tokens.txt \
/path/to/some.wav
```

## FAQs

### sherpa-onnx/csrc/online-wenet-ctc-model.cc:Init:144 head does not exist in the metadata

```
/Users/fangjun/open-source/sherpa-onnx/sherpa-onnx/csrc/online-wenet-ctc-model.
↳ cc:Init:144 head does not exist in the metadata
```

To fix the above error, please check the following two items:

- Make sure you are using `model-streaming.onnx` or `model-streaing.int8.onnx`. The executable you are running requires a streaming model as input.
- Make sure you use the script from `sherpa-onnx` to export your model.

## All models from WeNet

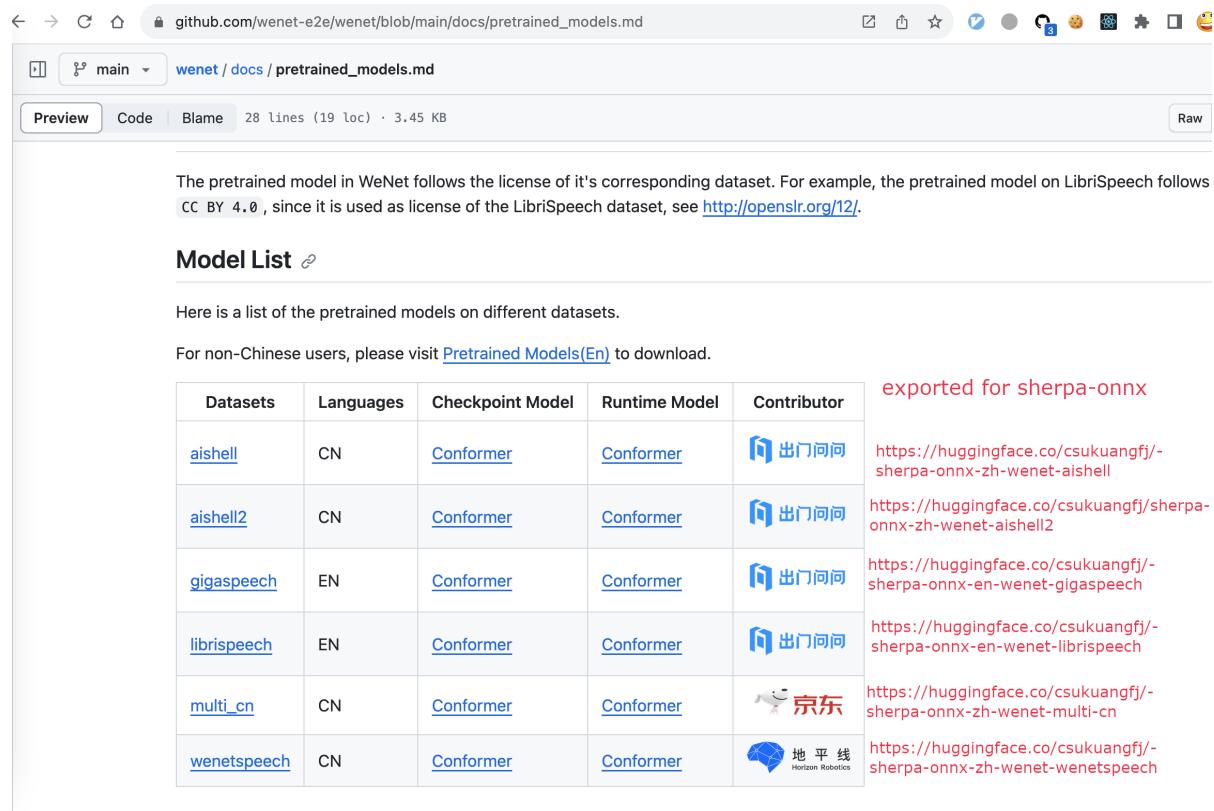
[https://github.com/wenet-e2e/wenet/blob/main/docs/pretrained\\_models.en.md](https://github.com/wenet-e2e/wenet/blob/main/docs/pretrained_models.en.md) lists all pre-trained models from WeNet and we have converted all of them to `sherpa-onnx` using the following script:

<https://github.com/k2-fsa/sherpa-onnx/blob/master/scripts/wenet/run.sh>.

We have uploaded the exported models to huggingface and you can find them from the following figure:

To make it easier to copy the links, we list them below:

- <https://huggingface.co/csukuangfj/sherpa-onnx-zh-wenet-aishell>
- <https://huggingface.co/csukuangfj/sherpa-onnx-zh-wenet-aishell2>
- <https://huggingface.co/csukuangfj/sherpa-onnx-en-wenet-gigaspeech>
- <https://huggingface.co/csukuangfj/sherpa-onnx-en-wenet-librispeech>
- <https://huggingface.co/csukuangfj/sherpa-onnx-zh-wenet-multi-cn>
- <https://huggingface.co/csukuangfj/sherpa-onnx-zh-wenet-wenetspeech>



The screenshot shows a GitHub repository page for `wenet`. The URL is `github.com/wenet-e2e/wenet/blob/main/docs/pretrained_models.md`. The page title is `wenet / docs / pretrained_models.md`. The content is a table of pre-trained models, with a note about the license and a link to the LibriSpeech dataset. The table includes columns for Datasets, Languages, Checkpoint Model, Runtime Model, Contributor, and a link to the corresponding Sherpa-ONNX model on Hugging Face.

Datasets	Languages	Checkpoint Model	Runtime Model	Contributor	exported for sherpa-onnx
<a href="#">aishell</a>	CN	<a href="#">Conformer</a>	<a href="#">Conformer</a>	 出门问问	<a href="https://huggingface.co/csukuangfj/-/sherpa-onnx-zh-wenet-aishell">https://huggingface.co/csukuangfj/-/sherpa-onnx-zh-wenet-aishell</a>
<a href="#">aishell2</a>	CN	<a href="#">Conformer</a>	<a href="#">Conformer</a>	 出门问问	<a href="https://huggingface.co/csukuangfj/sherpa-onnx-zh-wenet-aishell2">https://huggingface.co/csukuangfj/sherpa-onnx-zh-wenet-aishell2</a>
<a href="#">gigaspeech</a>	EN	<a href="#">Conformer</a>	<a href="#">Conformer</a>	 出门问问	<a href="https://huggingface.co/csukuangfj/-/sherpa-onnx-en-wenet-gigaspeech">https://huggingface.co/csukuangfj/-/sherpa-onnx-en-wenet-gigaspeech</a>
<a href="#">librispeech</a>	EN	<a href="#">Conformer</a>	<a href="#">Conformer</a>	 出门问问	<a href="https://huggingface.co/csukuangfj/-/sherpa-onnx-en-wenet-librispeech">https://huggingface.co/csukuangfj/-/sherpa-onnx-en-wenet-librispeech</a>
<a href="#">multi_cn</a>	CN	<a href="#">Conformer</a>	<a href="#">Conformer</a>	 京东	<a href="https://huggingface.co/csukuangfj/-/sherpa-onnx-zh-wenet-multi-cn">https://huggingface.co/csukuangfj/-/sherpa-onnx-zh-wenet-multi-cn</a>
<a href="#">wenetspeech</a>	CN	<a href="#">Conformer</a>	<a href="#">Conformer</a>	 地平线 Horizon Robotics	<a href="https://huggingface.co/csukuangfj/-/sherpa-onnx-zh-wenet-wenetspeech">https://huggingface.co/csukuangfj/-/sherpa-onnx-zh-wenet-wenetspeech</a>

Fig. 8.29: All pre-trained models from WeNet.

## Colab

We provide a colab notebook for you to try the exported WeNet models with sherpa-onnx.

### 8.22.10 Small models

In this section, we list online/streaming models with fewer parameters that are suitable for resource constrained embedded systems.

---

**Hint:** You can use them as a first pass model in a two-pass system, where the second pass uses a non-streaming model.

---

**Hint:** If you are using Raspberry Pi 4, this section is not so helpful for you since all models in sherpa-onnx are able to run in real-time on it.

This page is especially useful for systems with less resource than Raspberry Pi 4.

---

- *csukuangfj/sherpa-onnx-streaming-zipformer-zh-14M-2023-02-23 (Chinese)*
- *csukuangfj/sherpa-onnx-streaming-zipformer-en-20M-2023-02-17 (English)*
- *sherpa-onnx-streaming-zipformer-small-bilingual-zh-en-2023-02-16 (Bilingual, Chinese + English)*

## 8.23 Speaker Identification

This page describes how to use `sherpa-onnx` for speaker identification.

Please first follow [Installation](#) and/or [Install the Python Package](#) to install `sherpa-onnx` before you continue.

Pre-trained models can be found at <https://github.com/k2-fsa/sherpa-onnx/releases/tag/speaker-recognition-models>

---

**Hint:** You can find Android APKs for each model at the following page

<https://k2-fsa.github.io/sherpa/onnx/speaker-identification/apk.html>

---

Please refer to <https://github.com/k2-fsa/sherpa-onnx/tree/master/python-api-examples> for usage examples.

## 8.24 Text-to-speech (TTS)

This page describes how to use `sherpa-onnx` for text-to-speech (TTS).

Please first follow [Installation](#) and/or [Install the Python Package](#) to install `sherpa-onnx` before you continue.

### 8.24.1 Huggingface space

We provide a huggingface space where you can try text-to-speech with `sherpa-onnx` from within your browser without installing anything.

---

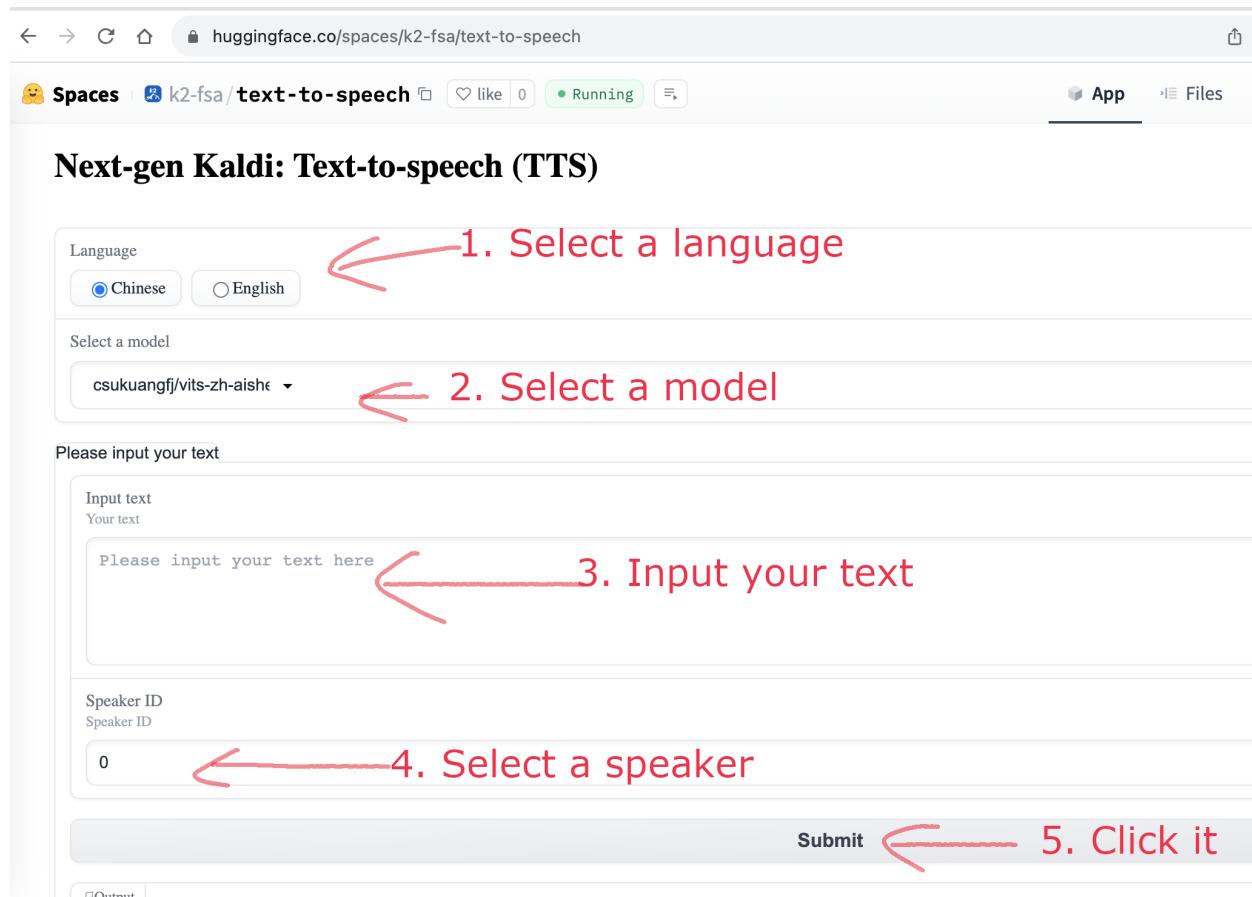
**Hint:** We also have spaces using `WebAssembly` for text-to-speech. Please see *Huggingface Spaces (WebAssembly)*.

---

All you need is a browser, either running on your desk computer, your phone, or your iPad, etc.

Please visit

<https://huggingface.co/spaces/k2-fsa/text-to-speech>



### 8.24.2 Pre-trained models

This page lists pre-trained models for text-to-speech.

---

**Hint:** Please install `git-lfs` before you continue.

Otherwise, you will be SAD later.

---

## vits

This page lists pre-trained `vits` models.

### All models in a single table

The following table summarizes the information of all models in this page.

---

**Note:** Since there are more than 100 pre-trained models for over 40 languages, we don't list all of them on this page. Please find them at <https://github.com/k2-fsa/sherpa-onnx/releases/tag/tts-models>.

You can try all the models at the following huggingface space. <https://huggingface.co/spaces/k2-fsa/text-to-speech>.

---

**Hint:** You can find Android APKs for each model at the following page

<https://k2-fsa.github.io/sherpa/onnx/tts/apk.html>

---

Model	Language	# Speakers	Dataset	Model filesize (MB)	Sample rate (Hz)
<code>cskuangfj/vits-zh-hf-fanchen-C</code> (Chinese, 187 speakers)	Chinese	187	N/A	116	16000
<code>cskuangfj/vits-zh-hf-fanchen-wnj</code> (Chinese, 1 male)	Chinese	1	N/A	116	16000
<code>cskuangfj/vits-zh-hf-theresa</code> (Chinese, 804 speakers)	Chinese	804	N/A	117	22050
<code>cskuangfj/vits-zh-hf-eula</code> (Chinese, 804 speakers)	Chinese	804	N/A	117	22050
<code>aishell3</code> (Chinese, multi-speaker, 174 speakers)	Chinese	174	aishell3	116	8000
<code>ljspeech</code> (English, single-speaker)	English (US)	1 (Female)	LJ Speech	109	22050
<code>VCTK</code> (English, multi-speaker, 109 speakers)	English	109	VCTK	116	22050
<code>en_US-lessac-medium</code> (English, single-speaker)	English (US)	1 (Male)	lessac_blizzard206B		22050

### `ljspeech` (English, single-speaker)

This model is converted from `pretrained_ljspeech.pth`, which is trained by the `vits` author Jaehyeon Kim on the `LJ Speech` dataset. It supports only English and is a single-speaker model.

---

**Note:** If you are interested in how the model is converted, please see <https://github.com/k2-fsa/sherpa-onnx/blob/master/scripts/vits/export-onnx-ljs.py>

---

In the following, we describe how to download it and use it with `sherpa-onnx`.

## Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/tts-models/vits-ljs.tar.bz2
tar xvf vits-ljs.tar.bz2
rm vits-ljs.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of \*.onnx files below.

```
-rw-r--r-- 1 1001 127 109M Apr 22 02:38 vits-ljs/vits-ljs.onnx
```

## Generate speech with executable compiled from C++

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline-tts \
--vits-model=./vits-ljs/vits-ljs.onnx \
--vits-lexicon=./vits-ljs/lexicon.txt \
--vits-tokens=./vits-ljs/tokens.txt \
--output-filename=./liliana.wav \
'liliana, the most beautiful and lovely assistant of our team!'
```

After running, it will generate a file `liliana.wav` in the current directory.

```
soxi ./liliana.wav

Input File      : './liliana.wav'
Channels        : 1
Sample Rate     : 22050
Precision       : 16-bit
Duration        : 00:00:04.39 = 96768 samples ~ 329.143 CDDA sectors
File Size       : 194k
Bit Rate        : 353k
Sample Encoding: 16-bit Signed Integer PCM
```

## Generate speech with Python script

```
cd /path/to/sherpa-onnx

python3 ./python-api-examples/offline-tts.py \
--vits-model=./vits-ljs/vits-ljs.onnx \
--vits-lexicon=./vits-ljs/lexicon.txt \
--vits-tokens=./vits-ljs/tokens.txt \
--output-filename=./armstrong.wav \
"That's one small step for a man, a giant leap for mankind."
```

After running, it will generate a file `armstrong.wav` in the current directory.

```
soxi ./armstrong.wav

Input File      : './armstrong.wav'
Channels       : 1
Sample Rate    : 22050
Precision      : 16-bit
Duration       : 00:00:04.81 = 105984 samples ~ 360.49 CDDA sectors
File Size      : 212k
Bit Rate       : 353k
Sample Encoding: 16-bit Signed Integer PCM
```

## VCTK (English, multi-speaker, 109 speakers)

This model is converted from `pretrained_vctk.pth`, which is trained by the `vits` author Jaehyeon Kim on the `VCTK` dataset. It supports only English and is a multi-speaker model. It contains 109 speakers.

---

**Note:** If you are interested in how the model is converted, please see <https://github.com/k2-fsa/sherpa-onnx/blob/master/scripts/vits/export-onnx-vctk.py>

---

In the following, we describe how to download it and use it with `sherpa-onnx`.

### Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/tts-models/vits-vctk.tar.bz2
tar xvf vits-vctk.tar.bz2
rm vits-vctk.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of `*.onnx` files below.

```
vits-vctk fangjun$ ls -lh *.onnx
-rw-r--r-- 1 fangjun staff 37M Oct 16 10:57 vits-vctk.int8.onnx
-rw-r--r-- 1 fangjun staff 116M Oct 16 10:57 vits-vctk.onnx
```

### Generate speech with executable compiled from C++

Since there are 109 speakers available, we can choose a speaker from 0 to 198. The default speaker ID is 0.

We use speaker ID 0, 10, and 108 below to generate audio for the same text.

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline-tts \
--vits-model=./vits-vctk/vits-vctk.onnx \
--vits-lexicon=./vits-vctk/lexicon.txt \
--vits-tokens=./vits-vctk/tokens.txt \
```

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```
--sid=0 \
--output-filename=./kennedy-0.wav \
'Ask not what your country can do for you; ask what you can do for your country.'

./build/bin/sherpa-onnx-offline-tts \
--vits-model=./vits-vctk/vits-vctk.onnx \
--vits-lexicon=./vits-vctk/lexicon.txt \
--vits-tokens=./vits-vctk/tokens.txt \
--sid=10 \
--output-filename=./kennedy-10.wav \
'Ask not what your country can do for you; ask what you can do for your country.'

./build/bin/sherpa-onnx-offline-tts \
--vits-model=./vits-vctk/vits-vctk.onnx \
--vits-lexicon=./vits-vctk/lexicon.txt \
--vits-tokens=./vits-vctk/tokens.txt \
--sid=108 \
--output-filename=./kennedy-108.wav \
'Ask not what your country can do for you; ask what you can do for your country.'
```

It will generate 3 files: kennedy-0.wav, kennedy-10.wav, and kennedy-108.wav.

### Generate speech with Python script

We use speaker ID 30, 66, and 99 below to generate audio for different transcripts.

```
cd /path/to/sherpa-onnx

python3 ./python-api-examples/offline-tts.py \
--vits-model=./vits-vctk/vits-vctk.onnx \
--vits-lexicon=./vits-vctk/lexicon.txt \
--vits-tokens=./vits-vctk/tokens.txt \
--sid=30 \
--output-filename=./einstein-30.wav \
"Life is like riding a bicycle. To keep your balance, you must keep moving."

python3 ./python-api-examples/offline-tts.py \
--vits-model=./vits-vctk/vits-vctk.onnx \
--vits-lexicon=./vits-vctk/lexicon.txt \
--vits-tokens=./vits-vctk/tokens.txt \
--sid=66 \
--output-filename=./franklin-66.wav \
"Three can keep a secret, if two of them are dead."

python3 ./python-api-examples/offline-tts.py \
--vits-model=./vits-vctk/vits-vctk.onnx \
--vits-lexicon=./vits-vctk/lexicon.txt \
--vits-tokens=./vits-vctk/tokens.txt \
--sid=99 \
--output-filename=./martin-99.wav \
"Darkness cannot drive out darkness: only light can do that. Hate cannot drive out
hate: only love can do that"
```

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It will generate 3 files: `einstein-30.wav`, `franklin-66.wav`, and `martin-99.wav`.

### csukuangfj/vits-zh-hf-fanchen-C (Chinese, 187 speakers)

You can download the model using the following commands:

```
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/tts-models/vits-zh-hf-
→fanchen-C.tar.bz2
tar xvf vits-zh-hf-fanchen-C.tar.bz2
rm vits-zh-hf-fanchen-C.tar.bz2
```

**Hint:** This model is converted from [https://huggingface.co/spaces/lkz99/tts\\_model/tree/main/zh](https://huggingface.co/spaces/lkz99/tts_model/tree/main/zh)

#### *# information about model files*

```
total 291M
-rw-r--r-- 1 1001 127 58K Apr 21 05:40 date.fst
drwxr-xr-x 3 1001 127 4.0K Apr 19 12:42 dict
-rwrxr-xr-x 1 1001 127 4.0K Apr 21 05:40 export-onnx-zh-hf-fanchen-models.py
-rwrxr-xr-x 1 1001 127 2.5K Apr 21 05:40 generate-lexicon-zh-hf-fanchen-models.py
-rw-r--r-- 1 1001 127 2.4M Apr 21 05:40 lexicon.txt
-rw-r--r-- 1 1001 127 22K Apr 21 05:40 new_heteronym.fst
-rw-r--r-- 1 1001 127 63K Apr 21 05:40 number.fst
-rw-r--r-- 1 1001 127 87K Apr 21 05:40 phone.fst
-rw-r--r-- 1 1001 127 173M Apr 21 05:40 rule.far
-rw-r--r-- 1 1001 127 331 Apr 21 05:40 tokens.txt
-rw-r--r-- 1 1001 127 116M Apr 21 05:40 vits-zh-hf-fanchen-C.onnx
-rwxr-xr-x 1 1001 127 2.0K Apr 21 05:40 vits-zh-hf-fanchen-models.sh
```

**usage:**

```
sherpa-onnx-offline-tts \
--vits-model=./vits-zh-hf-fanchen-C/vits-zh-hf-fanchen-C.onnx \
--vits-dict-dir=./vits-zh-hf-fanchen-C/dict \
--vits-lexicon=./vits-zh-hf-fanchen-C/lexicon.txt \
--vits-tokens=./vits-zh-hf-fanchen-C/tokens.txt \
--vits-length-scale=0.5 \
--output-filename="./value-2x.wav" \
...
```

```
sherpa-onnx-offline-tts \
--vits-model=./vits-zh-hf-fanchen-C/vits-zh-hf-fanchen-C.onnx \
--vits-dict-dir=./vits-zh-hf-fanchen-C/dict \
--vits-lexicon=./vits-zh-hf-fanchen-C/lexicon.txt \
--vits-tokens=./vits-zh-hf-fanchen-C/tokens.txt \
--vits-length-scale=1.0 \
--tts-rule-fsts=./vits-zh-hf-fanchen-C/number.fst \
```

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```
--output-filename="../numbers.wav" \
"14"

sherpa-onnx-offline-tts \
--sid=100 \
--vits-model=./vits-zh-hf-fanchen-C/vits-zh-hf-fanchen-C.onnx \
--vits-dict-dir=./vits-zh-hf-fanchen-C/dict \
--vits-lexicon=./vits-zh-hf-fanchen-C/lexicon.txt \
--vits-tokens=./vits-zh-hf-fanchen-C/tokens.txt \
--vits-length-scale=1.0 \
--tts-rule-fsts=./vits-zh-hf-fanchen-C/phone.fst,./vits-zh-hf-fanchen-C/number.fst \
--output-filename="../numbers-100.wav" \
"110 18601200909"

sherpa-onnx-offline-tts \
--sid=14 \
--vits-model=./vits-zh-hf-fanchen-C/vits-zh-hf-fanchen-C.onnx \
--vits-dict-dir=./vits-zh-hf-fanchen-C/dict \
--vits-lexicon=./vits-zh-hf-fanchen-C/lexicon.txt \
--vits-tokens=./vits-zh-hf-fanchen-C/tokens.txt \
--vits-length-scale=1.0 \
--output-filename="../wo-mi-14.wav" \
"""

sherpa-onnx-offline-tts \
--sid=102 \
--vits-model=./vits-zh-hf-fanchen-C/vits-zh-hf-fanchen-C.onnx \
--vits-dict-dir=./vits-zh-hf-fanchen-C/dict \
--vits-lexicon=./vits-zh-hf-fanchen-C/lexicon.txt \
--vits-tokens=./vits-zh-hf-fanchen-C/tokens.txt \
--tts-rule-fsts=./vits-zh-hf-fanchen-C/number.fst \
--vits-length-scale=1.0 \
--output-filename="../heteronym-102.wav" \
"35, 91"
```

### csukuangfj/vits-zh-hf-fanchen-wnj (Chinese, 1 male)

You can download the model using the following commands:

```
 wget https://github.com/k2-fsa/sherpa-onnx/releases/download/tts-models/vits-zh-hf-
 ↪fanchen-wnj.tar.bz2
 tar xvf vits-zh-hf-fanchen-wnj.tar.bz2
 rm vits-zh-hf-fanchen-wnj.tar.bz2
```

**Hint:** This model is converted from [https://huggingface.co/spaces/lkz99/tts\\_model/blob/main/G\\_wnj\\_latest.pth](https://huggingface.co/spaces/lkz99/tts_model/blob/main/G_wnj_latest.pth)

```
# information about model files
total 594760
-rw-r--r-- 1 fangjun staff 58K Apr 21 13:40 date.fst
```

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```
drwxr-xr-x  9 fangjun  staff  288B Apr 19 20:42 dict
-rw xr-xr-x  1 fangjun  staff  3.9K Apr 21 13:40 export-onnx-zh-hf-fanchen-models.py
-rw xr-xr-x  1 fangjun  staff  2.4K Apr 21 13:40 generate-lexicon-zh-hf-fanchen-models.py
-rw-r--r--  1 fangjun  staff  2.3M Apr 21 13:40 lexicon.txt
-rw-r--r--  1 fangjun  staff  21K Apr 21 13:40 new_heteronym.fst
-rw-r--r--  1 fangjun  staff  63K Apr 21 13:40 number.fst
-rw-r--r--  1 fangjun  staff  87K Apr 21 13:40 phone.fst
-rw-r--r--  1 fangjun  staff  172M Apr 21 13:40 rule.far
-rw-r--r--  1 fangjun  staff  331B Apr 21 13:40 tokens.txt
-rw xr-xr-x  1 fangjun  staff  1.9K Apr 21 13:40 vits-zh-hf-fanchen-models.sh
-rw-r--r--  1 fangjun  staff  115M Apr 21 13:40 vits-zh-hf-fanchen-wnj.onnx
```

**usage:**

```
sherpa-onnx-offline-tts \
  --vits-model=./vits-zh-hf-fanchen-wnj/vits-zh-hf-fanchen-wnj.onnx \
  --vits-dict-dir=./vits-zh-hf-fanchen-wnj/dict \
  --vits-lexicon=./vits-zh-hf-fanchen-wnj/lexicon.txt \
  --vits-tokens=./vits-zh-hf-fanchen-wnj/tokens.txt \
  --output-filename="./kuayue.wav" \
  ...

sherpa-onnx-offline-tts \
  --vits-model=./vits-zh-hf-fanchen-wnj/vits-zh-hf-fanchen-wnj.onnx \
  --vits-dict-dir=./vits-zh-hf-fanchen-wnj/dict \
  --vits-lexicon=./vits-zh-hf-fanchen-wnj/lexicon.txt \
  --vits-tokens=./vits-zh-hf-fanchen-wnj/tokens.txt \
  --tts-rule-fsts=./vits-zh-hf-fanchen-wnj/number.fst \
  --output-filename="./os.wav" \
  "14"
```

## csukuangfj/vits-zh-hf-theresa (Chinese, 804 speakers)

You can download the model with the following commands:

```
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/tts-models/vits-zh-hf-
theresa.tar.bz2
tar xvf vits-zh-hf-theresa.tar.bz2
rm vits-zh-hf-theresa.tar.bz2
```

**Hint:** This model is converted from [https://huggingface.co/spaces/zomehwh/vits-models-genshin-bh3/tree/main/pretrained\\_models/theresa](https://huggingface.co/spaces/zomehwh/vits-models-genshin-bh3/tree/main/pretrained_models/theresa)

```
# information about model files

total 596992
-rw-r--r--  1 fangjun  staff   58K Apr 21 13:39 date.fst
drwxr-xr-x  9 fangjun  staff  288B Apr 19 20:42 dict
-rw-r--r--  1 fangjun  staff  2.6M Apr 21 13:39 lexicon.txt
```

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```
-rw-r--r-- 1 fangjun staff 21K Apr 21 13:39 new_heteronym.fst
-rw-r--r-- 1 fangjun staff 63K Apr 21 13:39 number.fst
-rw-r--r-- 1 fangjun staff 87K Apr 21 13:39 phone.fst
-rw-r--r-- 1 fangjun staff 172M Apr 21 13:39 rule.far
-rw-r--r-- 1 fangjun staff 116M Apr 21 13:39 theresa.onnx
-rw-r--r-- 1 fangjun staff 268B Apr 21 13:39 tokens.txt
-rwxr-xr-x 1 fangjun staff 5.3K Apr 21 13:39 vits-zh-hf-models.py
-rwxr-xr-x 1 fangjun staff 571B Apr 21 13:39 vits-zh-hf-models.sh
```

usage:

```
sherpa-onnx-offline-tts \
--vits-model=./vits-zh-hf-theresa/theresa.onnx \
--vits-dict-dir=./vits-zh-hf-theresa/dict \
--vits-lexicon=./vits-zh-hf-theresa/lexicon.txt \
--vits-tokens=./vits-zh-hf-theresa/tokens.txt \
--sid=0 \
--output-filename="./reai-0.wav" \
""

sherpa-onnx-offline-tts \
--vits-model=./vits-zh-hf-theresa/theresa.onnx \
--vits-dict-dir=./vits-zh-hf-theresa/dict \
--vits-lexicon=./vits-zh-hf-theresa/lexicon.txt \
--vits-tokens=./vits-zh-hf-theresa/tokens.txt \
--tts-rule-fsts=./vits-zh-hf-theresa/number.fst \
--debug=1 \
--sid=88 \
--output-filename="./mi14-88.wav" \
"141000000"
```

**csukuangfj/vits-zh-hf-eula (Chinese, 804 speakers)**

You can download the model using the following commands:

```
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/tts-models/vits-zh-hf-eula.
tar.bz2
tar xvf vits-zh-hf-eula.tar.bz2
rm vits-zh-hf-eula.tar.bz2
```

**Hint:** This model is converted from [https://huggingface.co/spaces/zomehwh/vits-models-genshin-bh3/tree/main/pretrained\\_models/eula](https://huggingface.co/spaces/zomehwh/vits-models-genshin-bh3/tree/main/pretrained_models/eula)

```
# information about model files

total 596992
-rw-r--r-- 1 fangjun staff 58K Apr 21 13:39 date.fst
drwxr-xr-x 9 fangjun staff 288B Apr 19 20:42 dict
-rw-r--r-- 1 fangjun staff 116M Apr 21 13:39 eula.onnx
```

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```
-rw-r--r-- 1 fangjun staff 2.6M Apr 21 13:39 lexicon.txt
-rw-r--r-- 1 fangjun staff 21K Apr 21 13:39 new_heteronym.fst
-rw-r--r-- 1 fangjun staff 63K Apr 21 13:39 number.fst
-rw-r--r-- 1 fangjun staff 87K Apr 21 13:39 phone.fst
-rw-r--r-- 1 fangjun staff 172M Apr 21 13:39 rule.far
-rw-r--r-- 1 fangjun staff 268B Apr 21 13:39 tokens.txt
-rwxr-xr-x 1 fangjun staff 5.3K Apr 21 13:39 vits-zh-hf-models.py
-rwxr-xr-x 1 fangjun staff 571B Apr 21 13:39 vits-zh-hf-models.sh
```

usage:

```
sherpa-onnx-offline-tts \
--vits-model=./vits-zh-hf-eula/eula.onnx \
--vits-dict-dir=./vits-zh-hf-eula/dict \
--vits-lexicon=./vits-zh-hf-eula/lexicon.txt \
--vits-tokens=./vits-zh-hf-eula/tokens.txt \
--debug=1 \
--sid=666 \
--output-filename="./news-666.wav" \
"""

sherpa-onnx-offline-tts \
--vits-model=./vits-zh-hf-eula/eula.onnx \
--vits-dict-dir=./vits-zh-hf-eula/dict \
--vits-lexicon=./vits-zh-hf-eula/lexicon.txt \
--vits-tokens=./vits-zh-hf-eula/tokens.txt \
--tts-rule-fsts=./vits-zh-hf-eula/number.fst \
--sid=99 \
--output-filename="./news-99.wav" \
"925"
```

### aishell3 (Chinese, multi-speaker, 174 speakers)

This model is trained on the aishell3 dataset using [icefall](#).

It supports only Chinese and it's a multi-speaker model and contains 174 speakers.

**Hint:** You can download the Android APK for this model at

<https://k2-fsa.github.io/sherpa/onnx/tts/apk-engine.html>

(Please search for vits-icefall-zh-aishell3 in the above Android APK page)

---

**Note:** If you are interested in how the model is converted, please see the documentation of [icefall](#).

If you are interested in training your own model, please also refer to [icefall](#).

[icefall](#) is also developed by us.

---

In the following, we describe how to download it and use it with [sherpa-onnx](#).

## Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/tts-models/vits-icefall-zh-
↪aishell3.tar.bz2
tar xvf vits-icefall-zh-aishell3.tar.bz2
rm vits-icefall-zh-aishell3.tar.bz2
```

Please check that the file sizes of the pre-trained models are correct. See the file sizes of \*.onnx files below.

```
vits-icefall-zh-aishell3 fangjun$ ls -lh *.onnx
-rw-r--r-- 1 fangjun staff 29M Mar 20 22:50 model.onnx
```

## Generate speech with executable compiled from C++

Since there are 174 speakers available, we can choose a speaker from 0 to 173. The default speaker ID is 0.

We use speaker ID 10, 33, and 99 below to generate audio for the same text.

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline-tts \
--vits-model=./vits-icefall-zh-aishell3/model.onnx \
--vits-lexicon=./vits-icefall-zh-aishell3/lexicon.txt \
--vits-tokens=./vits-icefall-zh-aishell3/tokens.txt \
--tts-rule-fsts=./vits-icefall-zh-aishell3/phone.fst,./vits-icefall-zh-aishell3/date.
↪fst,./vits-icefall-zh-aishell3/number.fst \
--sid=10 \
--output-filename=./liliana-10.wav \
"""

./build/bin/sherpa-onnx-offline-tts \
--vits-model=./vits-icefall-zh-aishell3/model.onnx \
--vits-lexicon=./vits-icefall-zh-aishell3/lexicon.txt \
--vits-tokens=./vits-icefall-zh-aishell3/tokens.txt \
--tts-rule-fsts=./vits-icefall-zh-aishell3/phone.fst,./vits-icefall-zh-aishell3/date.
↪fst,./vits-icefall-zh-aishell3/number.fst \
--sid=33 \
--output-filename=./liliana-33.wav \
"""

./build/bin/sherpa-onnx-offline-tts \
--vits-model=./vits-icefall-zh-aishell3/model.onnx \
--vits-lexicon=./vits-icefall-zh-aishell3/lexicon.txt \
--vits-tokens=./vits-icefall-zh-aishell3/tokens.txt \
--tts-rule-fsts=./vits-icefall-zh-aishell3/phone.fst,./vits-icefall-zh-aishell3/date.
↪fst,./vits-icefall-zh-aishell3/number.fst \
--sid=99 \
--output-filename=./liliana-99.wav \
""
```

It will generate 3 files: `liliana-10.wav`, `liliana-33.wav`, and `liliana-99.wav`.

We also support rule-based text normalization, which is implemented with [OpenFst](#). Currently, only number normalization is supported.

---

**Hint:** We will support other normalization rules later.

---

The following is an example:

```
./build/bin/sherpa-onnx-offline-tts \
--vits-model=./vits-icefall-zh-aishell3/model.onnx \
--vits-lexicon=./vits-icefall-zh-aishell3/lexicon.txt \
--vits-tokens=./vits-icefall-zh-aishell3/tokens.txt \
--tts-rule-fsts=./vits-icefall-zh-aishell3/phone.fst,./vits-icefall-zh-aishell3/date.
fst,./vits-icefall-zh-aishell3/number.fst \
--sid=66 \
--output-filename=./rule-66.wav \
"35, 91"
```

## Generate speech with Python script

We use speaker ID 21, 41, and 45 below to generate audio for different transcripts.

```
cd /path/to/sherpa-onnx

python3 ./python-api-examples/offline-tts.py \
--vits-model=./vits-icefall-zh-aishell3/model.onnx \
--vits-lexicon=./vits-icefall-zh-aishell3/lexicon.txt \
--vits-tokens=./vits-icefall-zh-aishell3/tokens.txt \
--tts-rule-fsts=./vits-icefall-zh-aishell3/phone.fst,./vits-icefall-zh-aishell3/date.
fst,./vits-icefall-zh-aishell3/number.fst \
--sid=21 \
--output-filename=./liubei-21.wav \
"""

python3 ./python-api-examples/offline-tts.py \
--vits-model=./vits-icefall-zh-aishell3/model.onnx \
--vits-lexicon=./vits-icefall-zh-aishell3/lexicon.txt \
--vits-tokens=./vits-icefall-zh-aishell3/tokens.txt \
--tts-rule-fsts=./vits-icefall-zh-aishell3/phone.fst,./vits-icefall-zh-aishell3/date.
fst,./vits-icefall-zh-aishell3/number.fst \
--sid=41 \
--output-filename=./demokelite-41.wav \
"""

python3 ./python-api-examples/offline-tts.py \
--vits-model=./vits-icefall-zh-aishell3/model.onnx \
--vits-lexicon=./vits-icefall-zh-aishell3/lexicon.txt \
--vits-tokens=./vits-icefall-zh-aishell3/tokens.txt \
--tts-rule-fsts=./vits-icefall-zh-aishell3/phone.fst,./vits-icefall-zh-aishell3/date.
fst,./vits-icefall-zh-aishell3/number.fst \
--sid=45 \
```

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```
--output-filename=./zhugeliang-45.wav \
...''
```

It will generate 3 files: liubei-21.wav, demokelite-41.wav, and zhugeliang-45.wav.

The Python script also supports rule-based text normalization.

```
python3 ./python-api-examples/offline-tts.py \
--vits-model=./vits-icefall-zh-aishell3/model.onnx \
--vits-lexicon=./vits-icefall-zh-aishell3/lexicon.txt \
--vits-tokens=./vits-icefall-zh-aishell3/tokens.txt \
--tts-rule-fsts=./vits-icefall-zh-aishell3/phone.fst,./vits-icefall-zh-aishell3/date.
↪fst,./vits-icefall-zh-aishell3/number.fst \
--sid=103 \
--output-filename=./rule-103.wav \
"7144349737831141177872411013812345678"
```

### en\_US-lessac-medium (English, single-speaker)

This model is converted from [https://huggingface.co/rhasspy/piper-voices/tree/main/en\\_US/lessac/medium](https://huggingface.co/rhasspy/piper-voices/tree/main/en_US/lessac/medium).

The dataset used to train the model is `lessac_blizzard2013`.

---

**Hint:** The model is from `piper`.

---

In the following, we describe how to download it and use it with `sherpa-onnx`.

#### Download the model

Please use the following commands to download it.

```
cd /path/to/sherpa-onnx

wget https://github.com/k2-fsa/sherpa-onnx/releases/download/tts-models/vits-piper-en_US-
↪lessac-medium.tar.bz2
tar xf vits-piper-en_US-lessac-medium.tar.bz2
```

---

**Hint:** You can find a lot of pre-trained models for over 40 languages at <<https://github.com/k2-fsa/sherpa-onnx/releases/tag/tts-models>>.

---

## Generate speech with executable compiled from C++

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline-tts \
--vits-model=./vits-piper-en_US-lessac-medium/en_US-lessac-medium.onnx \
--vits-data-dir=./vits-piper-en_US-lessac-medium/espeak-ng-data \
--vits-tokens=./vits-piper-en_US-lessac-medium/tokens.txt \
--output-filename=./liliana-piper-en_US-lessac-medium.wav \
'liliana, the most beautiful and lovely assistant of our team!'
```

**Hint:** You can also use

```
cd /path/to/sherpa-onnx

./build/bin/sherpa-onnx-offline-tts-play \
--vits-model=./vits-piper-en_US-lessac-medium/en_US-lessac-medium.onnx \
--vits-data-dir=./vits-piper-en_US-lessac-medium/espeak-ng-data \
--vits-tokens=./vits-piper-en_US-lessac-medium/tokens.txt \
--output-filename=./liliana-piper-en_US-lessac-medium.wav \
'liliana, the most beautiful and lovely assistant of our team!'
```

which will play the audio as it is generating.

After running, it will generate a file `liliana-piper.wav` in the current directory.

```
soxi ./liliana-piper-en_US-lessac-medium.wav

Input File      : './liliana-piper-en_US-lessac-medium.wav'
Channels        : 1
Sample Rate     : 22050
Precision       : 16-bit
Duration        : 00:00:03.48 = 76800 samples ~ 261.224 CDDA sectors
File Size       : 154k
Bit Rate        : 353k
Sample Encoding: 16-bit Signed Integer PCM
```

## Generate speech with Python script

```
cd /path/to/sherpa-onnx

python3 ./python-api-examples/offline-tts.py \
--vits-model=./vits-piper-en_US-lessac-medium/en_US-lessac-medium.onnx \
--vits-data-dir=./vits-piper-en_US-lessac-medium/espeak-ng-data \
--vits-tokens=./vits-piper-en_US-lessac-medium/tokens.txt \
--output-filename=./armstrong-piper-en_US-lessac-medium.wav \
"That's one small step for a man, a giant leap for mankind."
```

**Hint:** You can also use

```
cd /path/to/sherpa-onnx

python3 ./python-api-examples/offline-tts-play.py \
--vits-model=./vits-piper-en_US-lessac-medium/en_US-lessac-medium.onnx \
--vits-data-dir=./vits-piper-en_US-lessac-medium/espeak-ng-data \
--vits-tokens=./vits-piper-en_US-lessac-medium/tokens.txt \
--output-filename=./armstrong-piper-en_US-lessac-medium.wav \
"That's one small step for a man, a giant leap for mankind."
```

which will play the audio as it is generating.

---

After running, it will generate a file `armstrong-piper-en_US-lessac-medium.wav` in the current directory.

```
soxi ./armstrong-piper-en_US-lessac-medium.wav

Input File      : './armstrong-piper-en_US-lessac-medium.wav'
Channels        : 1
Sample Rate     : 22050
Precision       : 16-bit
Duration        : 00:00:03.74 = 82432 samples ~ 280.381 CDDA sectors
File Size       : 165k
Bit Rate        : 353k
Sample Encoding: 16-bit Signed Integer PCM
```

### 8.24.3 WebAssembly

In this section, we describe how to build text-to-speech from `sherpa-onnx` for `WebAssembly` so that you can run text-to-speech with `WebAssembly`.

Please follow the steps below to build and run `sherpa-onnx` for `WebAssembly`.

---

**Hint:** We provide a colab notebook for you to try this section step by step.

If you are using Windows or you don't want to setup your local environment to build `WebAssembly` support, please use the above colab notebook.

---

#### Install Emscripten

We need to compile the C/C++ files in `sherpa-onnx` with the help of `emscripten`.

Please refer to [https://emscripten.org/docs/getting\\_started/downloads](https://emscripten.org/docs/getting_started/downloads) for detailed installation instructions.

The following is an example to show you how to install it on Linux/macOS.

```
git clone https://github.com/emscripten-core/emsdk.git
cd emsdk
git pull
./emsdk install latest
./emsdk activate latest
source ./emsdk_env.sh
```

To check that you have installed `emscripten` successfully, please run:

```
emcc -v
```

The above command should print something like below:

```
emcc (Emscripten gcc/clang-like replacement + linker emulating GNU ld) 3.1.48
  ↵(e967e20b4727956a30592165a3c1cde5c67fa0a8)
shared:INFO: (Emscripten: Running sanity checks)
(py38) fangjuns-MacBook-Pro:open-source fangjun$ emcc -v
emcc (Emscripten gcc/clang-like replacement + linker emulating GNU ld) 3.1.48
  ↵(e967e20b4727956a30592165a3c1cde5c67fa0a8)
clang version 18.0.0 (https://github.com/llvm/llvm-project
  ↵a54545ba6514802178cf7cf1c1dd9f7efbf3cde7)
Target: wasm32-unknown-emscripten
Thread model: posix
InstalledDir: /Users/fangjun/open-source/emsdk/upstream/bin
```

Congratulations! You have successfully installed `emscripten`.

## Build

After installing `emscripten`, we can build text-to-speech from `sherpa-onnx` for WebAssembly now.

Please use the following command to build it:

```
git clone https://github.com/k2-fsa/sherpa-onnx
cd sherpa-onnx

cd wasm/tts/assets

wget -q https://github.com/k2-fsa/sherpa-onnx/releases/download/tts-models/vits-piper-en_
  ↵US-libritts_r-medium.tar.bz2
tar xf vits-piper-en_US-libritts_r-medium.tar.bz2
rm vits-piper-en_US-libritts_r-medium.tar.bz2
mv vits-piper-en_US-libritts_r-medium/en_US-libritts_r-medium.onnx ./model.onnx
mv vits-piper-en_US-libritts_r-medium/tokens.txt ./
mv vits-piper-en_US-libritts_r-medium/espeak-ng-data ./
rm -rf vits-piper-en_US-libritts_r-medium

cd ../../..
./build-wasm-simd-tts.sh
```

**Hint:** You can visit <https://github.com/k2-fsa/sherpa-onnx/releases/tag/tts-models> to download a different model.

After building, you should see the following output:

```
Install the project...
-- Install configuration: "Release"
-- Installing: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-tts/install/lib/
  ↵libkaldi-native-fbank-core.a
-- Installing: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-tts/install/lib/
  ↵libkaldi-decoder-core.a
```

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```
-- Installing: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-tts/install/lib/
→ libsherpa-onnx-kaldifst-core.a
-- Installing: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-tts/install/lib/
→ libsherpa-onnx-fst.a
-- Installing: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-tts/install/lib/
→ libonnxruntime.a
-- Installing: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-tts/install/lib/
→ libespeak-ng.a
-- Installing: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-tts/install/lib/
→ libucd.a
-- Up-to-date: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-tts/install/lib/
→ libucd.a
-- Installing: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-tts/install/lib/
→ libpiper_phonemize.a
-- Installing: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-tts/install/./
→ sherpa-onnx.pc
-- Installing: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-tts/install/lib/
→ pkgconfig/espeak-ng.pc
-- Installing: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-tts/install/share/
→ vim/vimfiles/ftdetect
-- Installing: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-tts/install/share/
→ vim/vimfiles/ftdetect/espeak filetype.vim
-- Installing: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-tts/install/share/
→ vim/vimfiles/syntax
-- Installing: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-tts/install/share/
→ vim/vimfiles/syntax/espeakrules.vim
-- Installing: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-tts/install/share/
→ vim/vimfiles/syntax/espeaklist.vim
-- Up-to-date: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-tts/install/lib/
→ libucd.a
-- Up-to-date: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-tts/install/lib/
→ libespeak-ng.a
-- Installing: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-tts/install/lib/
→ libsherpa-onnx-core.a
-- Installing: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-tts/install/lib/
→ libsherpa-onnx-c-api.a
-- Installing: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-tts/install/
→ include/sherpa-onnx/c-api/c-api.h
-- Installing: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-tts/install/bin/
→ wasm/tts/sherpa-onnx-wasm-main.js
-- Up-to-date: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-tts/install/bin/
→ wasm/tts/sherpa-onnx-wasm-main.js
-- Installing: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-tts/install/bin/
→ wasm/tts/index.html
-- Installing: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-tts/install/bin/
→ wasm/tts/sherpa-onnx.js
-- Installing: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-tts/install/bin/
→ wasm/tts/app.js
-- Installing: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-tts/install/bin/
→ wasm/tts/sherpa-onnx-wasm-main.wasm
-- Installing: /Users/fangjun/open-source/sherpa-onnx/build-wasm-simd-tts/install/bin/
→ wasm/tts/sherpa-onnx-wasm-main.data
```

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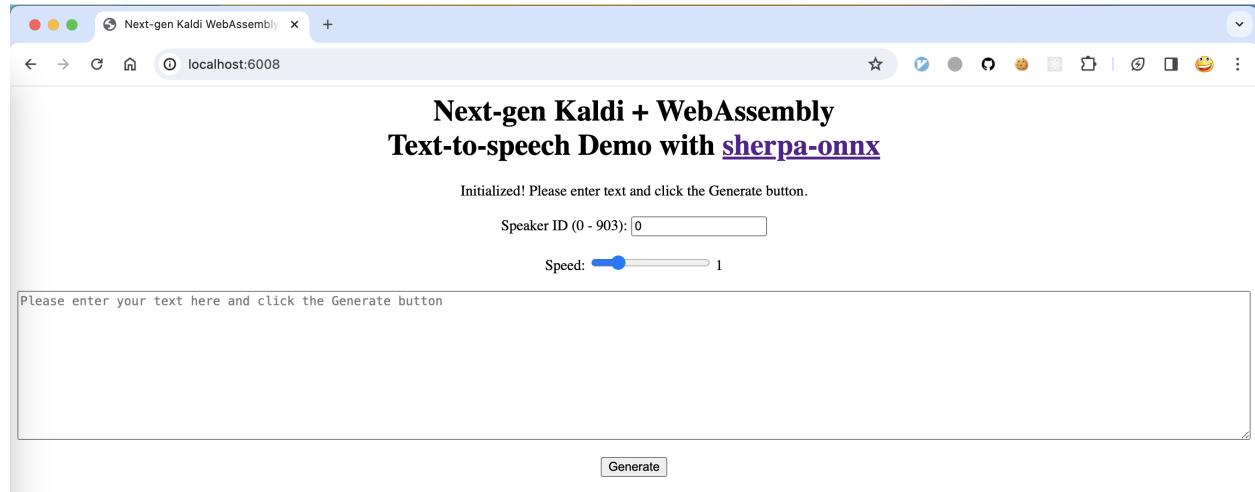
(continued from previous page)

```
+ ls -lh install/bin/wasm/tts
total 211248
-rw-r--r-- 1 fangjun staff 5.3K Feb 22 09:18 app.js
-rw-r--r-- 1 fangjun staff 1.3K Feb 22 09:18 index.html
-rw-r--r-- 1 fangjun staff 92M Feb 22 10:35 sherpa-onnx-wasm-main.data
-rw-r--r-- 1 fangjun staff 117K Feb 22 10:39 sherpa-onnx-wasm-main.js
-rw-r--r-- 1 fangjun staff 11M Feb 22 10:39 sherpa-onnx-wasm-main.wasm
-rw-r--r-- 1 fangjun staff 4.5K Feb 22 09:18 sherpa-onnx.js
```

Now you can use the following command to run it:

```
cd build-wasm-simd-tts/install/bin/wasm/tts
python3 -m http.server 6008
```

Start your browser and visit <http://localhost:6008/>; you should see the following page:



Now you can enter some text and click **Generate**

A screenshot is given below:

Congratulations! You have successfully run text-to-speech with [WebAssembly](#) in your browser.

## Huggingface Spaces (WebAssembly)

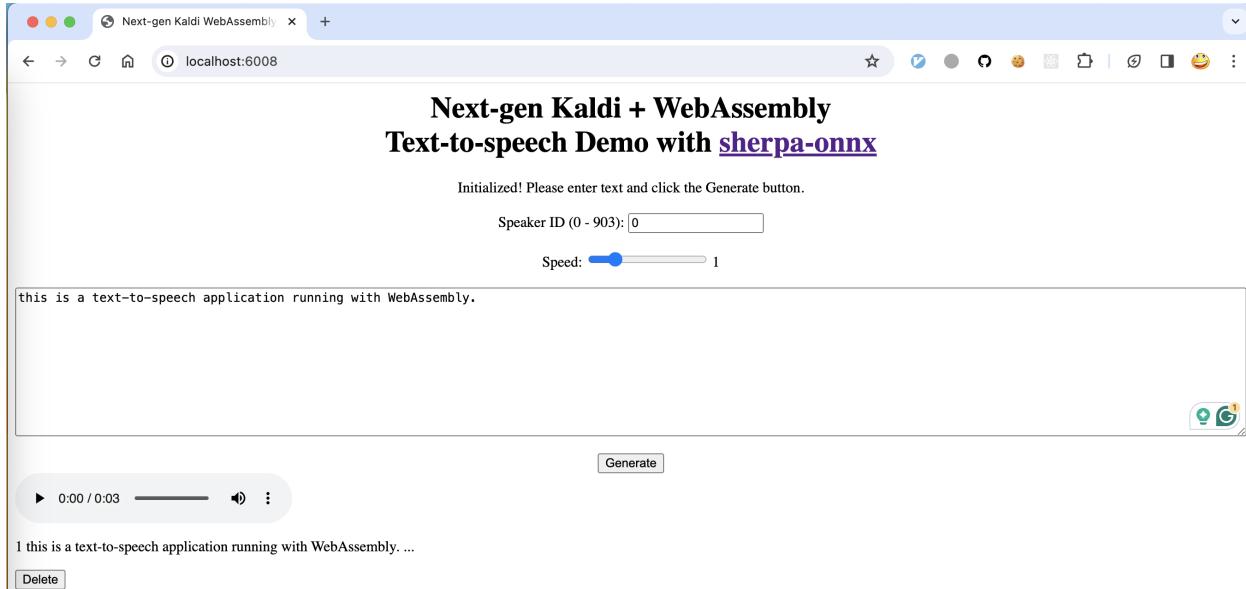
We provide two [Huggingface](#) spaces so that you can try text-to-speech with [WebAssembly](#) in your browser.

### English TTS

<https://huggingface.co/spaces/k2-fsa/web-assembly-tts-sherpa-onnx-en>

**Hint:** If you don't have access to [Huggingface](#), please visit the following mirror:

<https://modelscope.cn/studios/k2-fsa/web-assembly-tts-sherpa-onnx-en/summary>



---

**Note:** The script for building this space can be found at <https://github.com/k2-fsa/sherpa-onnx/blob/master/.github/workflows/wasm-simd-hf-space-en-tts.yaml>

---

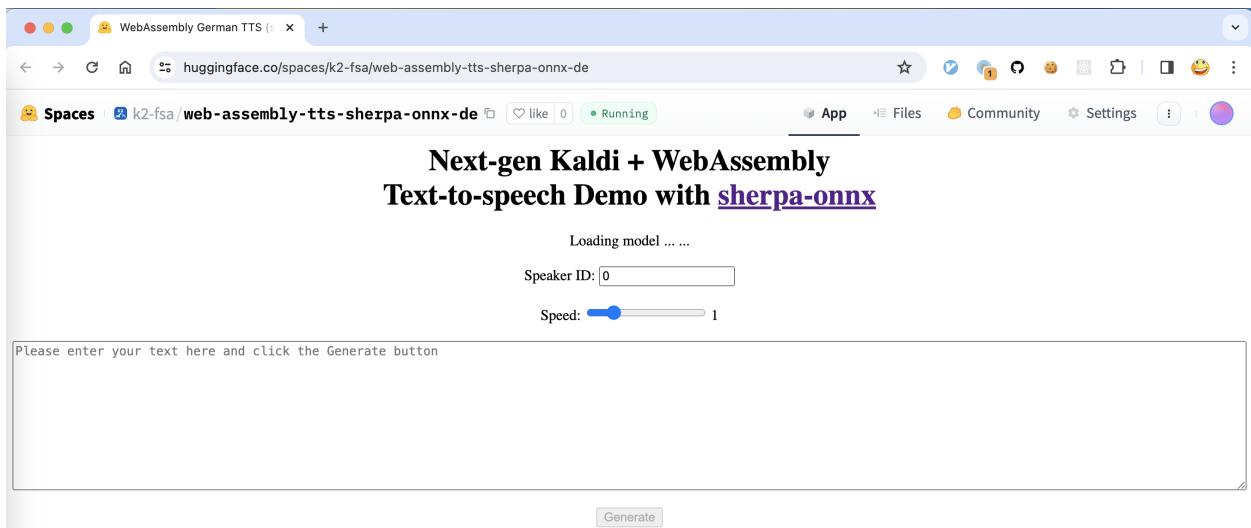
## German TTS

<https://huggingface.co/spaces/k2-fsa/web-assembly-tts-sherpa-onnx-de>

**Hint:** If you don't have access to Huggingface, please visit the following mirror:

<https://modelscope.cn/studios/k2-fsa/web-assembly-tts-sherpa-onnx-de/summary>

---




---

**Note:** The script for building this space can be found at <https://github.com/k2-fsa/sherpa-onnx/blob/master/.github/workflows/wasm-simd-hf-space-de-tts.yaml>

---

## 8.24.4 Piper

In this section, we describe how to convert `piper` pre-trained models from <https://huggingface.co/rhasspy/piper-voices>.

**Hint:**

You can find all of the converted models from `piper` in the following address:

<https://github.com/k2-fsa/sherpa-onnx/releases/tag/tts-models>

If you want to convert your own pre-trained `piper` models or if you want to learn how the conversion works, please read on.

Otherwise, you only need to download the converted models from the above link.

---

Note that there are pre-trained models for over 30 languages from `piper`. All models share the same converting method, so we use an American English model in this section as an example.

## Install dependencies

```
pip install onnx onnxruntime
```

---

**Hint:** We suggest that you always use the latest version of onnxruntime.

---

## Find the pre-trained model from piper

All American English models from piper can be found at [https://huggingface.co/rhasspy/piper-voices/tree/main/en/en\\_US](https://huggingface.co/rhasspy/piper-voices/tree/main/en/en_US).

We use [https://huggingface.co/rhasspy/piper-voices/tree/main/en/en\\_US/amy/low](https://huggingface.co/rhasspy/piper-voices/tree/main/en/en_US/amy/low) as an example in this section.

## Download the pre-trained model

We need to download two files for each model:

```
wget https://huggingface.co/rhasspy/piper-voices/resolve/main/en/en_US/amy/low/en_US-amy-
˓→low.onnx
wget https://huggingface.co/rhasspy/piper-voices/resolve/main/en/en_US/amy/low/en_US-amy-
˓→low.onnx.json
```

## Add meta data to the onnx model

Please use the following code to add meta data to the downloaded onnx model.

```
#!/usr/bin/env python3

import json
import os
from typing import Any, Dict

import onnx

def add_meta_data(filename: str, meta_data: Dict[str, Any]):
    """Add meta data to an ONNX model. It is changed in-place.

    Args:
        filename:
            Filename of the ONNX model to be changed.
        meta_data:
            Key-value pairs.
    """
    model = onnx.load(filename)
    for key, value in meta_data.items():
        meta = model.metadata_props.add()
        meta.key = key
        meta.value = str(value)
```

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```

onnx.save(model, filename)

def load_config(model):
    with open(f"{model}.json", "r") as file:
        config = json.load(file)
    return config

def generate_tokens(config):
    id_map = config["phoneme_id_map"]
    with open("tokens.txt", "w", encoding="utf-8") as f:
        for s, i in id_map.items():
            f.write(f"{s} {i[0]}\n")
    print("Generated tokens.txt")

def main():
    # Caution: Please change the filename
    filename = "en_US-amy-low.onnx"

    # The rest of the file should not be changed.
    # You only need to change the above filename = "xxx.onnx" in this file

    config = load_config(filename)

    print("generate tokens")
    generate_tokens(config)

    print("add model metadata")
    meta_data = {
        "model_type": "vits",
        "comment": "piper", # must be piper for models from piper
        "language": config["language"]["name_english"],
        "voice": config["espeak"]["voice"], # e.g., en-us
        "has_espeak": 1,
        "n_speakers": config["num_speakers"],
        "sample_rate": config["audio"]["sample_rate"],
    }
    print(meta_data)
    add_meta_data(filename, meta_data)

main()

```

After running the above script, your `en_US-amy-low.onnx` is updated with meta data and it also generates a new file `tokens.txt`.

From now on, you don't need the config json file `en_US-amy-low.onnx.json` any longer.

## Download espeak-ng-data

```
wget https://github.com/k2-fsa/sherpa-onnx/releases/download/tts-models/espeak-ng-data.  
tar.bz2  
tar xf espeak-ng-data.tar.bz2
```

Note that `espeak-ng-data.tar.bz2` is shared by all models from `piper`, no matter which language your are using for your model.

## Test your converted model

To have a quick test of your converted model, you can use

```
pip install sherpa-onnx
```

to install `sherpa-onnx` and then use the following commands to test your model:

```
# The command "pip install sherpa-onnx" will install several binaries,  
# including the following one  
  
which sherpa-onnx-offline-tts  
  
sherpa-onnx-offline-tts \  
  --vits-model=./en_US-amy-low.onnx \  
  --vits-tokens=./tokens.txt \  
  --vits-data-dir=./espeak-ng-data \  
  --output-filename=./test.wav \  
  "How are you doing? This is a text-to-speech application using next generation Kaldi."
```

The above command should generate a wave file `test.wav`.

Congratulations! You have successfully converted a model from `piper` and run it with `sherpa-onnx`.

## 8.24.5 MMS

This section describes how to convert models from <https://huggingface.co/facebook/mms-tts/tree/main> to `sherpa-onnx`.

Note that `facebook/mms-tts` supports more than 1000 languages. You can try models from `facebook/mms-tts` at the huggingface space <https://huggingface.co/spaces/mms-meta/MMS>.

You can try the converted models by visiting <https://huggingface.co/spaces/k2-fsa/text-to-speech>. To download the converted models, please visit <https://github.com/k2-fsa/sherpa-onnx/releases/tag/tts-models>. If a filename contains `vits-mms`, it means the model is from `facebook/mms-tts`.

## Install dependencies

```
pip install -qq onnx scipy Cython
pip install -qq torch==1.13.0+cpu -f https://download.pytorch.org/whl/torch_stable.html
```

## Download the model file

Suppose that we want to convert the English model, we need to use the following commands to download the model:

```
name=eng
wget -q https://huggingface.co/facebook/mms-tts/resolve/main/models/$name/G_100000.pth
wget -q https://huggingface.co/facebook/mms-tts/resolve/main/models/$name/config.json
wget -q https://huggingface.co/facebook/mms-tts/resolve/main/models/$name/vocab.txt
```

## Download MMS source code

```
git clone https://huggingface.co/spaces/mms-meta/MMS
export PYTHONPATH=$PWD/MMS:$PYTHONPATH
export PYTHONPATH=$PWD/MMS/vits:$PYTHONPATH

pushd MMS/vits/monotonic_align

python3 setup.py build

ls -lh build/
ls -lh build/lib*/
ls -lh build/lib*/*/

cp build/lib*/vits/monotonic_align/core*.so .

sed -i.bak s/.monotonic_align.core/.core/g ./__init__.py
popd
```

## Convert the model

Please save the following code into a file with name `./vits-mms.py`:

```
#!/usr/bin/env python3

import collections
import os
from typing import Any, Dict

import onnx
import torch
from vits import commons, utils
from vits.models import SynthesizerTrn
```

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```

class OnnxModel(torch.nn.Module):
    def __init__(self, model: SynthesizerTrn):
        super().__init__()
        self.model = model

    def forward(
        self,
        x,
        x_lengths,
        noise_scale=0.667,
        length_scale=1.0,
        noise_scale_w=0.8,
    ):
        return self.model.infer(
            x=x,
            x_lengths=x_lengths,
            noise_scale=noise_scale,
            length_scale=length_scale,
            noise_scale_w=noise_scale_w,
        )[0]

def add_meta_data(filename: str, meta_data: Dict[str, Any]):
    """Add meta data to an ONNX model. It is changed in-place.

    Args:
        filename:
            Filename of the ONNX model to be changed.
        meta_data:
            Key-value pairs.
    """
    model = onnx.load(filename)
    for key, value in meta_data.items():
        meta = model.metadata_props.add()
        meta.key = key
        meta.value = str(value)

    onnx.save(model, filename)

def load_vocab():
    return [
        x.replace("\n", "") for x in open("vocab.txt", encoding="utf-8").readlines()
    ]

@torch.no_grad()
def main():
    hps = utils.get_hparams_from_file("config.json")
    is_uroman = hps.data.training_files.split(".")[-1] == "uroman"
    if is_uroman:
        raise ValueError("We don't support uroman!")

```

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```

symbols = load_vocab()

# Now generate tokens.txt
all_upper_tokens = [i.upper() for i in symbols]
duplicate = set(
    [
        item
        for item, count in collections.Counter(all_upper_tokens).items()
        if count > 1
    ]
)

print("generate tokens.txt")

with open("tokens.txt", "w", encoding="utf-8") as f:
    for idx, token in enumerate(symbols):
        f.write(f"{token} {idx}\n")

        # both upper case and lower case correspond to the same ID
        if (
            token.lower() != token.upper()
            and len(token.upper()) == 1
            and token.upper() not in duplicate
        ):
            f.write(f"{token.upper()} {idx}\n")

net_g = SynthesizerTrn(
    len(symbols),
    hps.data.filter_length // 2 + 1,
    hps.train.segment_size // hps.data.hop_length,
    **hps.model,
)
net_g.cpu()
_ = net_g.eval()

_ = utils.load_checkpoint("G_100000.pth", net_g, None)

model = OnnxModel(net_g)

x = torch.randint(low=1, high=10, size=(50,), dtype=torch.int64)
x = x.unsqueeze(0)

x_length = torch.tensor([x.shape[1]], dtype=torch.int64)
noise_scale = torch.tensor([1], dtype=torch.float32)
length_scale = torch.tensor([1], dtype=torch.float32)
noise_scale_w = torch.tensor([1], dtype=torch.float32)

opset_version = 13

filename = "model.onnx"

```

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```

torch.onnx.export(
    model,
    (x, x_length, noise_scale, length_scale, noise_scale_w),
    filename,
    opset_version=opset_version,
    input_names=[
        "x",
        "x_length",
        "noise_scale",
        "length_scale",
        "noise_scale_w",
    ],
    output_names=["y"],
    dynamic_axes={
        "x": {0: "N", 1: "L"}, # n_audio is also known as batch_size
        "x_length": {0: "N"},
        "y": {0: "N", 2: "L"},
    },
)
meta_data = {
    "model_type": "vits",
    "comment": "mms",
    "url": "https://huggingface.co/facebook/mms-tts/tree/main",
    "add_blank": int(hps.data.add_blank),
    "language": os.environ.get("language", "unknown"),
    "frontend": "characters",
    "n_speakers": int(hps.data.n_speakers),
    "sample_rate": hps.data.sampling_rate,
}
print("meta_data", meta_data)
add_meta_data(filename=filename, meta_data=meta_data)

main()

```

The you can run it with:

```

export PYTHONPATH=$PWD/MMS:$PYTHONPATH
export PYTHONPATH=$PWD/MMS/vits:$PYTHONPATH
export lang=eng
python3 ./vits-mms.py

```

It will generate the following two files:

- `model.onnx`
- `tokens.txt`

## Use the converted model

We can use the converted model with the following command after installing `sherpa-onnx`.

```
./build/bin/sherpa-onnx-offline-tts \
--vits-model=./model.onnx \
--vits-tokens=./tokens.txt \
--debug=1 \
--output-filename=./mms-eng.wav \
"How are you doing today? This is a text-to-speech application using models from \
facebook with next generation Kaldi"
```

The above command should generate a wave file `mms-eng.wav`.

Congratulations! You have successfully converted a model from `MMS` and run it with `sherpa-onnx`.

We are using `eng` in this section as an example, you can replace it with other languages, such as `deu` for German, `fra` for French, etc.

### 8.24.6 Frequently Asked Question (FAQs)

#### Is there a colab notebook

Yes, we have one. Please see

[https://github.com/k2-fsa/colab/blob/master/sherpa-onnx/Text\\_to\\_speech\\_with\\_sherpa\\_onnx.ipynb](https://github.com/k2-fsa/colab/blob/master/sherpa-onnx/Text_to_speech_with_sherpa_onnx.ipynb)

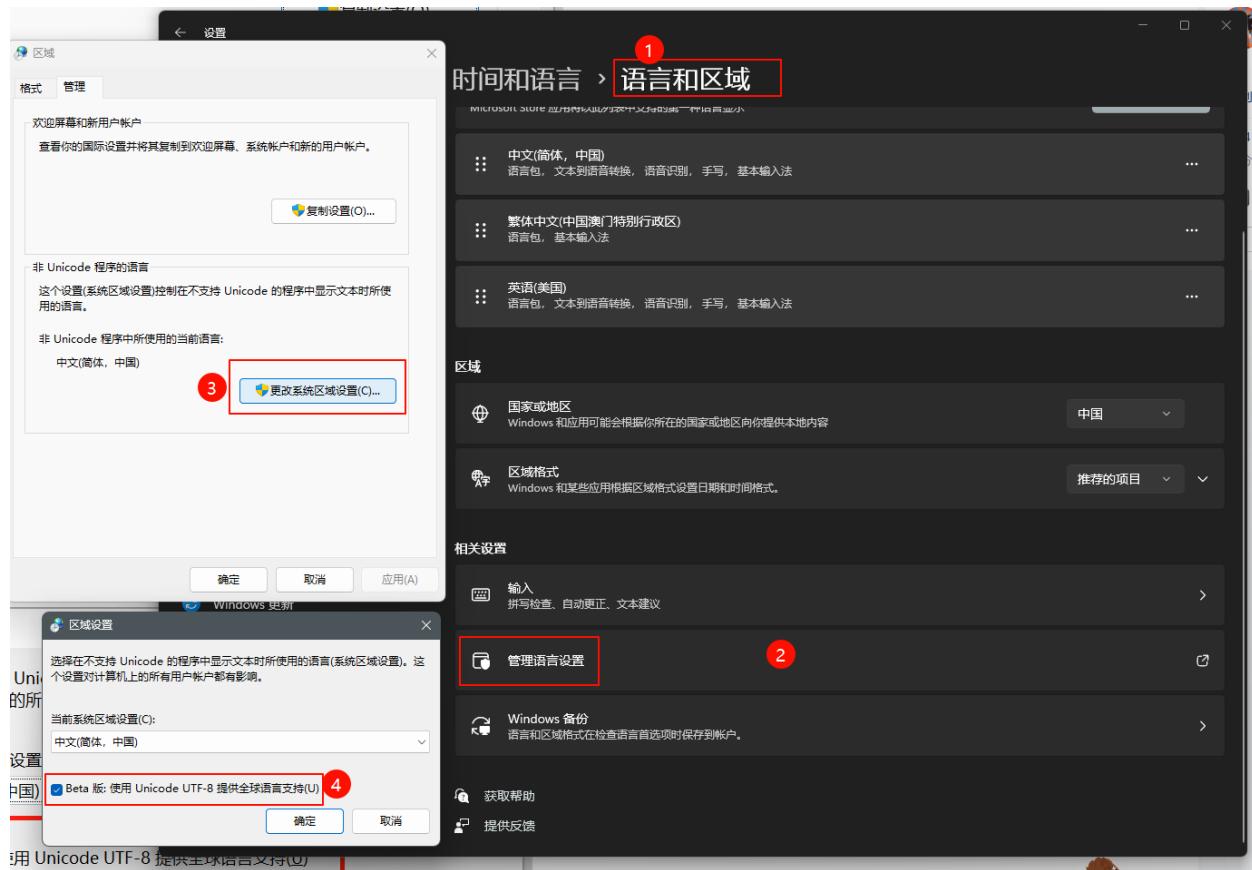
It shows you

- How to install `sherpa-onnx`
- How to download pre-trained text-to-speech (TTS) models
- How to use `sherpa-onnx` with pre-trained models for TTS

## How to enable UTF-8 on Windows

For Chinese Users: [issue](#)

Please see [win11 cmdutf-8](#)



## How to install sherpa-onnx for TTS

### For Python users

The fastest way to install `sherpa-onnx` for TTS is:

```
pip install sherpa-onnx
```

The above command does NOT require you to install a C++ compiler and it supports a variety of platforms, such as:

- Linux
  - x64
  - arm, e.g., 32-bit Raspberry Pi
  - arm64, e.g., 64-bit Raspberry Pi
- Windows
  - x64, e.g., 64-bit Windows
  - x86, e.g., 32-bit Windows

- macOS
  - x64
  - arm64, e.g., M1 and M2 chips

If you want to build the `sherpa-onnx` Python package from source, please refer to [Install the Python Package](#).

After installation, please refer to <https://github.com/k2-fsa/sherpa-onnx/blob/master/python-api-examples/offline-tts.py> for example usage.

---

**Hint:** `pip install sherpa-onnx` also installs an executable `sherpa-onnx-offline-tts`. The directory where it is installed should be already on your PATH after you activate your Python virtual environment.

You can run

```
sherpa-onnx-offline-tts --help
```

in your terminal to get the help information about it.

---

## Build from source

Please refer to [Installation](#).

## Where to get pre-trained TTS models

Please refer to [Pre-trained models](#).

## How to handle OOVs

Please add them to `lexicon.txt`.



**TRITON**

Nvidia [Triton](#) Inference Server provides a cloud and edge inferencing solution optimized for both CPUs and GPUs.

The following content describes how to deploy ASR models trained by [icefall](#) using Triton.

## 9.1 Installation

We prepare a dockerfile based on official triton docker containers. The customized dockerfile intergrates [Triton-server](#), [Triton-client](#) and sherpa-related requirements into a single image. You need to install [Docker](#) first before starting installation.

---

**Hint:** For your production environment, you could build triton manually to reduce the size of container.

---

### 9.1.1 Build Triton Image

```
git clone https://github.com/k2-fsa/sherpa
cd sherpa/triton
docker build . -f Dockerfile/Dockerfile.server -t sherpa_triton_server:latest
```

---

**Note:** It may take a lot of time since we build k2 from source. If you only need to use greedy search scorer, you could comment k2-related lines.

---

### 9.1.2 Launch a inference container

```
docker run --gpus all --name sherpa_server --net host --shm-size=1g -it sherpa_triton_
server:latest
```

Now, you should enter into the container successfully.

## 9.2 Triton-server

This page gives several examples to deploy streaming and offline ASR pretrained models with Triton server.

### 9.2.1 Deploy streaming ASR models with Onnx

First, we need to export pretrained models with Onnx.

```
export SHERPA_SRC=../sherpa
export ICEFALL_SRC=/workspace/icefall
# copy essentials
cp $SHERPA_SRC/triton/scripts/*onnx*.py $ICEFALL_DIR/egs/wenetspeech/ASR/pruned_
˓→stateless_transducer5/
cd $ICEFALL_SRC/egs/wenetspeech/ASR/
# download pretrained models
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/luomingshuang/icefall_asr_
˓→wenetspeech_pruned_transducer_stateless5_streaming
cd ./icefall_asr_wenetspeech_pruned_transducer_stateless5_streaming
git lfs pull --include "exp/pretrained_epoch_7_avg_1.pt"
cd -
# export to onnx fp16
ln -s ./icefall_asr_wenetspeech_pruned_transducer_stateless5_streaming/exp/pretrained_
˓→epoch_7_avg_1.pt ./icefall_asr_wenetspeech_pruned_transducer_stateless5_streaming/exp/
˓→epoch-999.pt
./pruned_transducer_stateless5/export_onnx.py \
--exp-dir ./icefall_asr_wenetspeech_pruned_transducer_stateless5_streaming/exp \
--tokenizer-file ./icefall_asr_wenetspeech_pruned_transducer_stateless5_streaming/
˓→data/lang_char \
--epoch 999 \
--avg 1 \
--streaming-model 1 \
--causal-convolution 1 \
--onnx 1 \
--left-context 64 \
--right-context 4 \
--fp16
```

---

**Note:** For Chinese models, `--tokenizer-file` points to `<pretrained_dir>/data/lang_char`. While for English models, it points to `<pretrained_dir>/data/lang_bpe_500/bpe.model` file.

---

Then, in the docker container, you could start the service with:

```
cd sherpa/triton/
bash scripts/start_streaming_server.sh
```

## 9.2.2 Deploy offline ASR models with torchscript

**Caution:** Currently, we only support FP32 offline ASR inference for torchscript backend. Streaming ASR and FP16 inference are not supported.

First, we need to export pretrained models using jit.

```
export SHERPA_SRC=./sherpa
export ICEFALL_SRC=/workspace/icefall
# Download pretrained models
GIT_LFS_SKIP_SMUDGE=1 git clone https://huggingface.co/csukuangfj/icefall-asr-
↪librispeech-pruned-transducer-stateless3-2022-04-29 $ICEFALL_DIR/egs/librispeech/ASR/
↪pruned_stateless_transducer3/
cd icefall-asr-librispeech-pruned-transducer-stateless3-2022-04-29
git lfs pull --include "exp/pretrained-epoch-25-avg-7.pt"
# export them to three jit models: encoder_jit.pt, decoder_jit.pt, joiner_jit.pt
cp $SHERPA_SRC/triton/scripts/conformer_triton.py $ICEFALL_DIR/egs/librispeech/ASR/
↪pruned_stateless_transducer3/
cp $SHERPA_SRC/triton/scripts/export_jit.py $ICEFALL_DIR/egs/librispeech/ASR/pruned_
↪stateless_transducer3/
cd $ICEFALL_DIR/egs/librispeech/ASR/pruned_stateless_transducer3
python3 export_jit.py \
    --pretrained-model $ICEFALL_DIR/egs/librispeech/ASR/pruned_stateless_transducer3/
↪icefall-asr-librispeech-pruned-transducer-stateless3-2022-04-29 \
    --output-dir <jit_model_dir> --bpe-model <bpe_model_path>
# copy bpe file to <jit_model_dir>, later we would mount <jit_model_dir> to the triton_
↪docker container
cp <bpe_model_path> <jit_model_dir>
```

**Note:** If you export models outside the docker container, you could mount the exported <jit\_model\_dir> with -v <host\_dir>:<container\_dir> when lauching the container.

Then, in the docker container, you could start the service with:

```
cd sherpa/triton/
bash scripts/start_offline_server_jit.sh
```

## 9.3 Triton-client

### 9.3.1 Send requests using client

In the docker container, run the client script to do ASR inference:

```
cd sherpa/triton/client
# Test one audio using offline ASR
python3 client.py --audio_file=~/test_wavs/1089-134686-0001.wav --url=localhost:8001
```

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```
# Test one audio using streaming ASR
python3 client.py --audio_file=./test_wavs/1089-134686-0001.wav --url=localhost:8001 --
→streaming
```

The above command sends a single audio `1089-134686-0001.wav` to the server and get the result. `--url` option specifies the IP and port of the server, in this example, we set the server and client on the same machine, therefore IP is `localhost`, and we use port `8001` since it is the default port for gRPC in Triton.

You can also test a bunch of audios together with the client. Just specify the path of `wav.scp` with `--wavscp` option, set the path of test set directory with `--data_dir` option, and set the path of ground-truth transcript file with `--trans` option, the client will infer all the audios in test set and calculate the WER upon the test set.

### 9.3.2 Decode manifests

You could also decode a whole dataset to benchmark metrics e.g. RTF, WER.

**Caution:** Decode manifests in simulation streaming mode would be supported in the future.

```
cd sherpa/triton/client

# For aishell manifests:
git lfs install
git clone https://huggingface.co/csukuangfj/aishell-test-dev-manifests
sudo mkdir -p /root/fangjun/open-source/icefall-aishell/egs/aishell/ASR/download/aishell
tar xf ./aishell-test-dev-manifests/data_aishell.tar.gz -C /root/fangjun/open-source/
→icefall-aishell/egs/aishell/ASR/download/aishell/
# dev set: ./aishell-test-dev-manifests/data/fbank/aishell_cuts_test.jsonl.gz
# test set: ./aishell-test-dev-manifests/data/fbank/aishell_cuts_test.jsonl.gz

python3 decode_manifest_triton.py \
  --server-addr localhost \
  --num-tasks 300 \
  --log-interval 20 \
  --model-name transducer \
  --manifest-filename ./aishell-test-dev-manifests/data/fbank/aishell_cuts_test.jsonl.
→gz \
  --compute-cer
```

## 9.4 Perf Analyzer

We can use `perf_analyzer` provided by Triton to test the performance of the service.

### 9.4.1 Generate Input Data from Audio Files

For offline ASR server:

```
cd sherpa/triton/client
# en
python3 generate_perf_input.py --audio_file=test_wavs/1089-134686-0001.wav
# zh
python3 generate_perf_input.py --audio_file=test_wavs/zh/mid.wav
```

It will generate a `offline_input.json` file in `sherpa/triton/client`.

For streaming ASR server, you need to add a `--streaming` option:

```
python3 generate_perf_input.py --audio_file=test_wavs/1089-134686-0001.wav --streaming
```

A `online_input.json` file would be generated.

### 9.4.2 Test Throughput using Perf Analyzer

```
# Offline ASR Test with grpc
perf_analyzer -m transducer -b 1 -a -p 20000 --concurrency-range 100:200:50 -i gRPC --
    ↵input-data=offline_input.json -u localhost:8001

# Streaming ASR Test with grpc
perf_analyzer -m transducer -b 1 -a -p 20000 --concurrency-range 100:200:50 -i gRPC --
    ↵input-data=online_input.json -u localhost:8001 --streaming
```

You could save the below results with a `-f log.txt` option.

Concurrency	Inferences/Second	Client Network+Server Queue	Server Send/Recv	Server Compute Input	Server Infer	Server Compute Output	Client Recv	p50 latency	p90 latency	p95 latency	p99 latency
300	226.24	109	230434	1	9314	1068792	14512	1	1254206616224958246551406		

**Note:** Please refer to [https://github.com/triton-inference-server/server/blob/main/docs/user\\_guide/perf\\_analyzer.md](https://github.com/triton-inference-server/server/blob/main/docs/user_guide/perf_analyzer.md) for advanced usage.

## 9.5 TensorRT acceleration

This page shows how to use TensorRT engine to accelerate inference speed for K2 models

### 9.5.1 Preparation

First of all, you have to install the TensorRT. Here we suggest you to use docker container to run TRT. Just run the following command:

```
docker run --gpus '"device=0"' -it --rm --net host -v $PWD:/k2 nvcr.io/nvidia/  
→tensorrt:22.12-py3
```

You can also see [here](#) to build TRT on your machine.

---

**Note:** Please pay attention that, the TRT version must have to  $\geq 8.5.3!!!$

---

If your TRT version is  $< 8.5.3$ , you can download the desired TRT version and then run the following command inside the docker container to use the TRT you just download:

```
# inside the container  
bash tools/install.sh
```

### 9.5.2 Model export

You have to prepare the ONNX model by referring [here](#) to export your models into ONNX format. Assume you have put your ONNX model in the `$model_dir` directory. Then, just run the command:

```
bash tools/build.sh $model_dir  
cp $model_dir/encoder.trt model_repo_offline_fast_beam_trt/encoder/1
```

The generated TRT model will be saved into `$model_dir/encoder.trt`. We also give an example of `model_repo` of TRT model. You can follow the same procedure as described [here](#) to deploy the pipeline using triton.

### 9.5.3 Benchmark for Conformer TRT encoder vs ONNX

Model	Batch size	Avg latency(ms)	QPS
ONNX	1	7.44	134.48
	8	14.92	536.09
	16	22.84	700.67
	32	41.62	768.84
	64	80.48	795.27
	128	171.97	744.32
TRT	1	5.21834	193.93
	8	11.7826	703.49
	16	20.4444	815.79
	32	37.583	893.56
	64	69.8312	965.40
	128	139.702	964.57