



Microsoft Surface + Azure Hackathon

HelpChat

Hybrid AI





20+

Years of Innovation

0

Advertising

100%

Growth Through
Client Results



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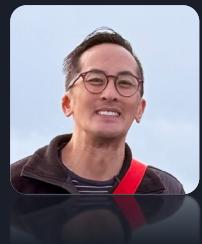
ABOUT ME



> 20 years at Teknikos



Worked on all types of
Microsoft solutions



Jonathan Khoo
CTO & VP Engineering



...rative and relative pronouns), definite noun phrase or proper name. Both
sentential (sentence) and intersentential (discourse) relations have been
important both for anaphora (a short-distance relation) and coreference
(on). Cataphoric relations were not encountered in the corpus. Coreference
occurred only between two discourse entities (NP1 and NP2) that refer to the
world, i.e. **identity coreference**, as presented in (van Deemter and
NP2 *corefer* if and only if *Referent(NP1) = Referent(NP2)*).

Using the entire set of ID variations, the top two parent categories for each were compiled into a list and counted by frequency. If there was a three-way tie (which occurred 9 times out of 40 rules), the parents were not separated into three different variation sets, but rather left as-is (e.g., ADJX/ADVX/DM was not split into ADJX/ADVX, ADVX/DM and ADJX/DM). The top five variations are: FKONJ/SIMPX, ADJX/NX, R-SIMPX/SIMPX, ADVX/PX, and ADVX/NX.

Results for the 10% cutoff – ambiguity heuristic follow:

(10%-ambig.)	Precision	Recall
Type	21.2% (7/33)	33.3% (7/21)

Overview

(1.2a) $\left[\begin{array}{l} \text{content} \\ \text{QSTORE } \{ \text{quant}^* \} \end{array} \right]$ (1.2b) $\left[\begin{array}{l} \text{word} \\ \dots \\ \text{NEW-QUANTIFIERS } \{ \text{quant}^* \} \end{array} \right]$

psoa nom-obj quant

(1.3) $\text{word} \rightarrow \text{Desc}_1 \vee \text{Desc}_2$

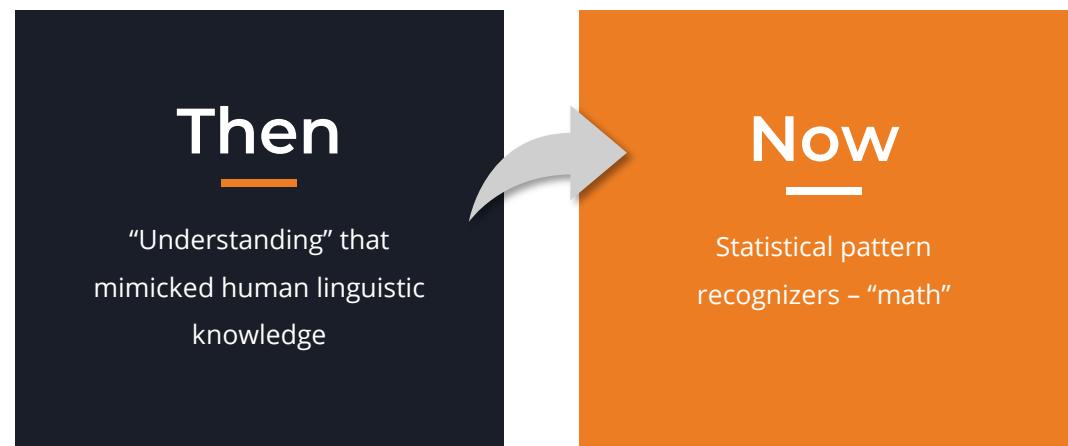
(1.4) $\text{Desc}_1 = \left[\begin{array}{l} \text{SS|LOC|CONT} \\ \text{QSTORE } \boxed{1} \end{array} \right] \vee \left[\begin{array}{l} \text{nom-obj} \vee \text{quant} \\ \text{QSTORE } \boxed{2} \end{array} \right] \vee \left[\begin{array}{l} \text{psoa} \\ \text{QSTORE } \boxed{3} \end{array} \right]$

where $\boxed{1} = \boxed{5} \cup \text{union QSTORES of selected arguments}$
 $\boxed{4} = \text{set of elements of } \boxed{3}$
 $\boxed{1} = \boxed{2} \cup \boxed{4}$

↳ Annotation of ambiguity

UNLOCKED POSSIBILITIES WITH COMPUTING POWER

Local and in the cloud



← Actual data, papers, and presentations from my 2005-2007 Masters degree classes

TERMINOLOGY



Transformers

Embedding vectors pass through layers of transformer operations that help the model better understand each word in context



Tokenization

Breaking text down into smaller units (tokens)

"I love chocolate"

→ ["I", "love", "chocolate"]



input_ids

Model's vocabulary-specific ID number for each token

["I", "love", "chocolate"]

→ [101, 4567, 9876]



Embedding

Vector representation of token, "learned" during training

Hundreds, thousands of dimensions encode meaning and context

Group of embeddings is a *tensor*



attention_mask

Tells model which tokens to pay attention to

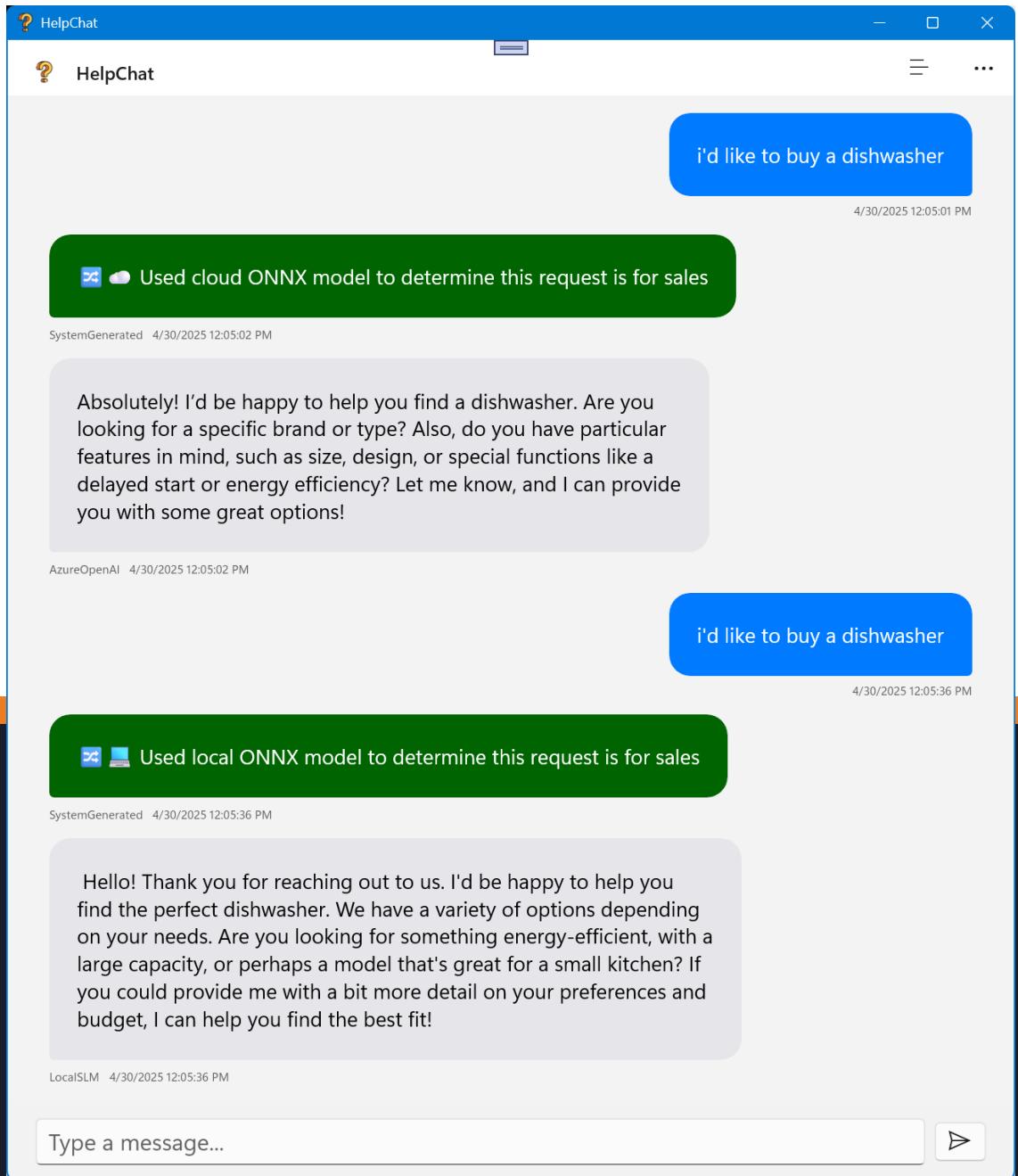
input_ids: [101, 4567, 9876, 0]

attention_mask: [1, 1, 1, 0]

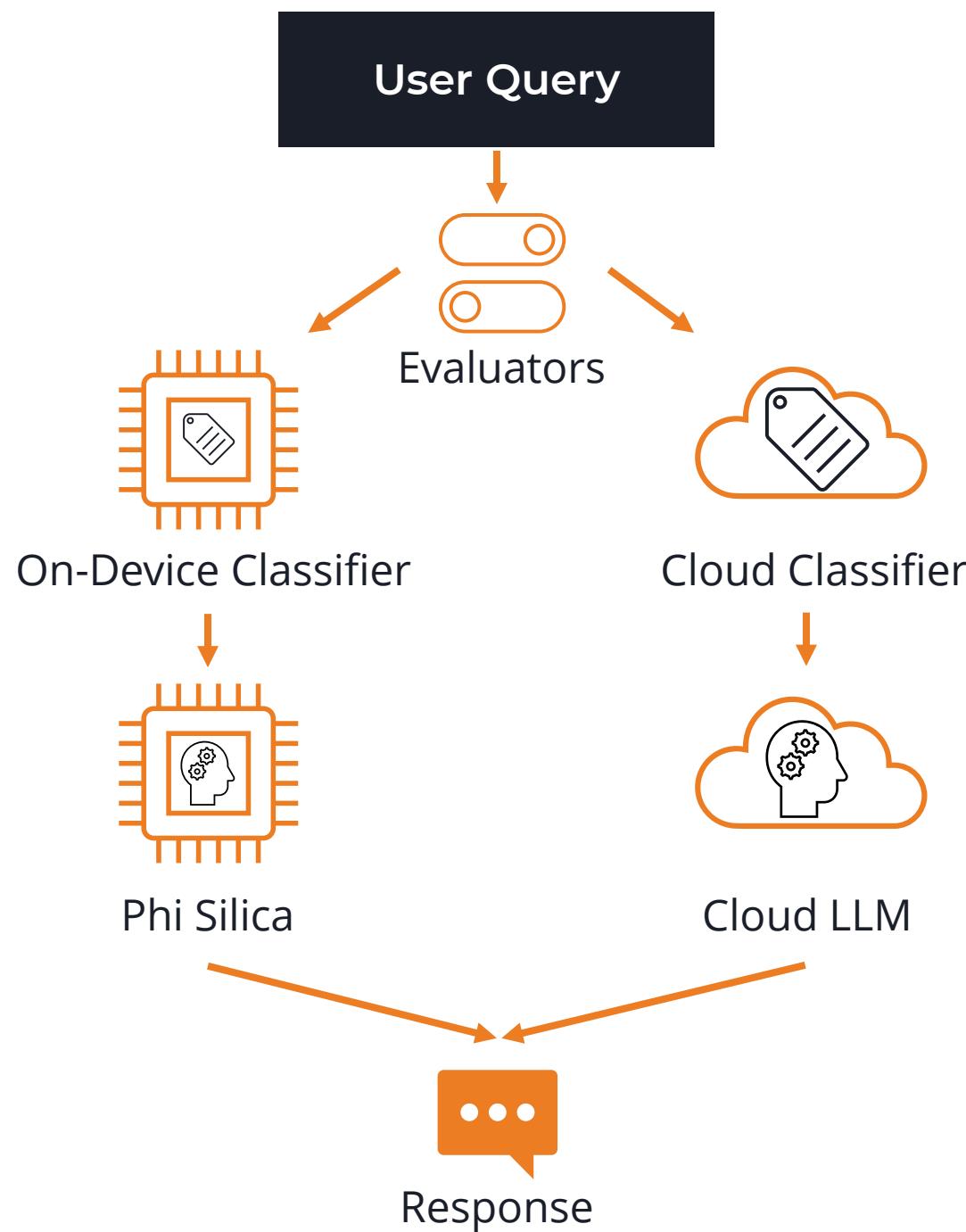
TODAY'S GOAL

Hybrid AI solution

- Probably not a real use case you'd build,
- BUT, a concrete example of possibilities on-device
AI opens up



FLOW & COMPONENTS



Evaluators

Go/No-Go

Classifier

Cross-Platform
ONNX Model

TO-DO LIST



Understand and Work with
an ONNX Model



Implement Cloud Version



Implement Evaluators



Implement Local Version

YOU ARE HERE



Understand and Work with
an ONNX Model



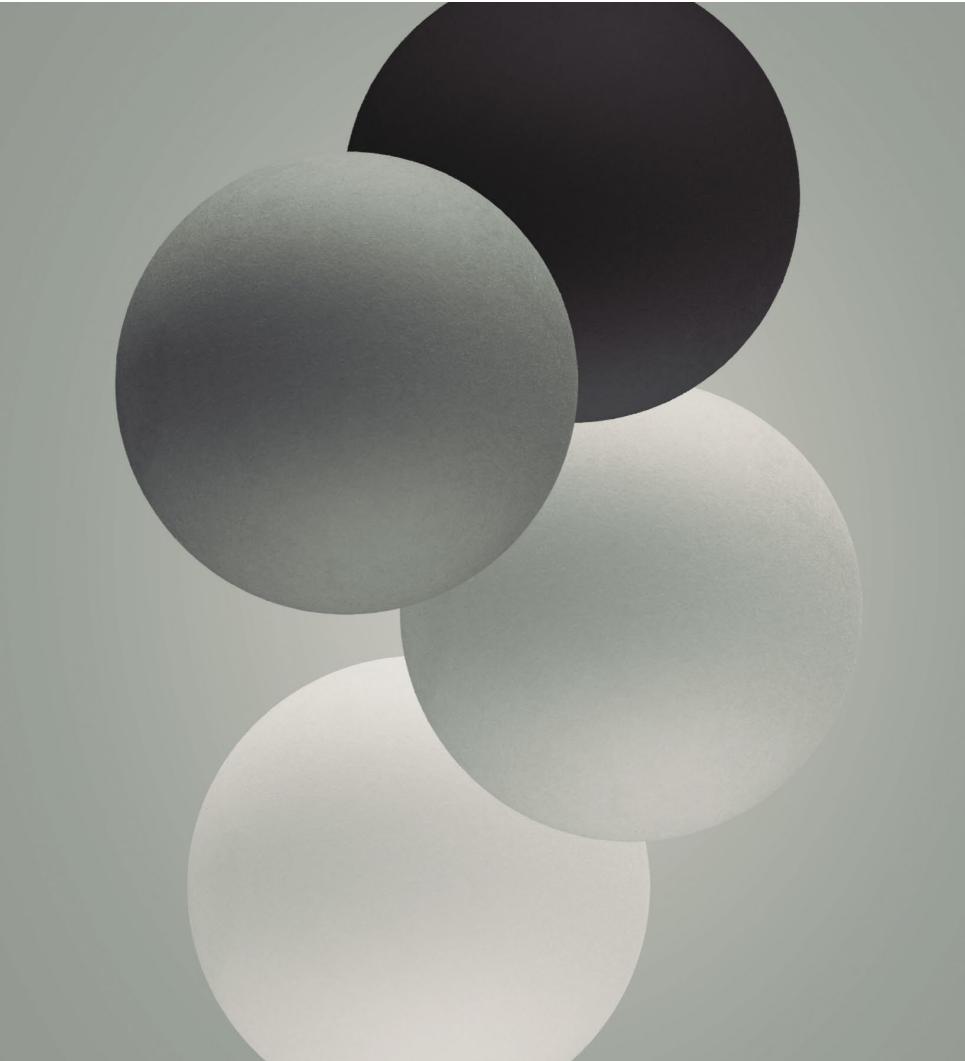
Implement Cloud Version



Implement Evaluators



Implement Local Version

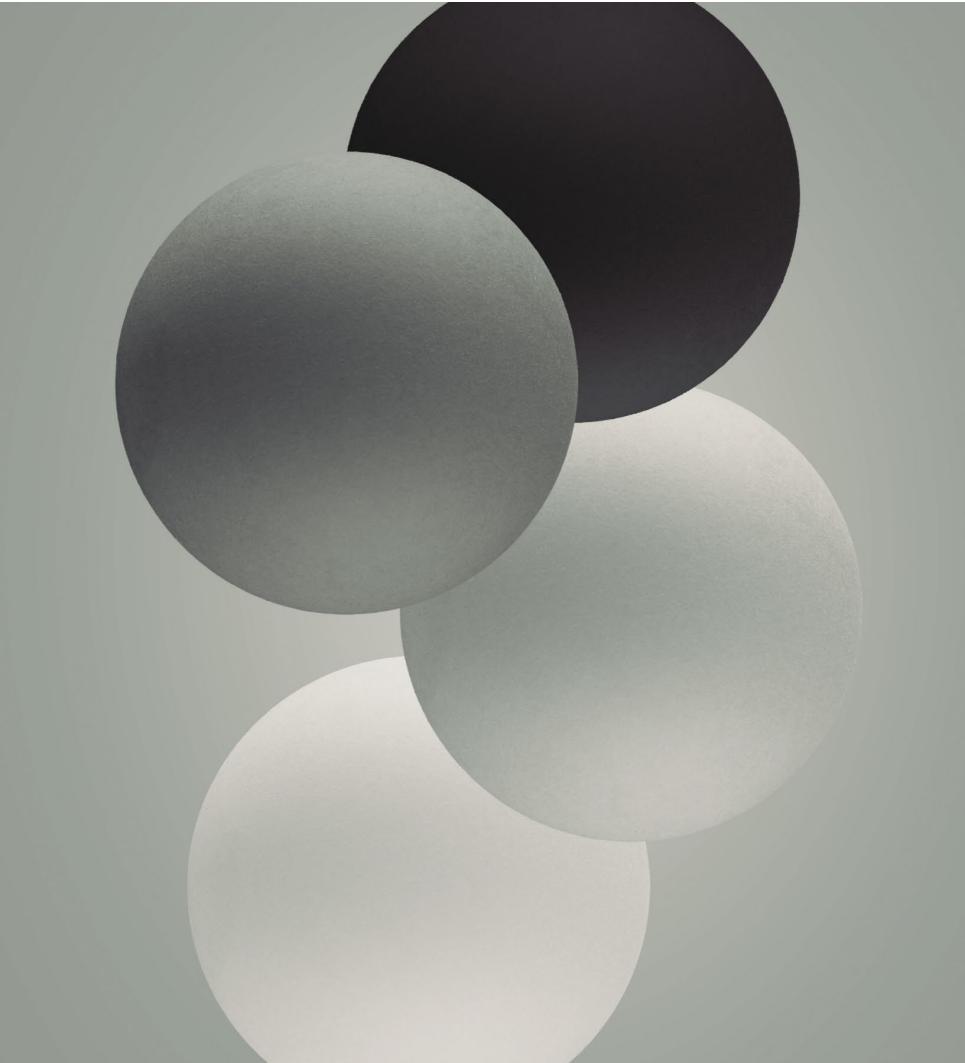


WHAT IS ONNX?

- Open Neural Network Exchange
 - Open format for AI models
 - Solves interoperability problems between frameworks like PyTorch and TensorFlow
 - ONNX Runtime
 - Cross-platform, multiple language support
 - *Execution providers* take advantage of hardware
 - Same model in the cloud and on the device
-



ONNX



GET AN ONNX MODEL

- Train in Azure Machine Learning
- Get a pretrained model in ONNX Model Zoo or some Hugging Face listings
- Convert an existing model to ONNX
 - Take advantage of existing AI deployments



ONNX

ZERO-SHOT CLASSIFICATION

“The prime minister met with international leaders.”

This text is about politics

This text is about weather

This text is about entertainment

This text is about sports

This text is about politics

This text is about science

Semantic similarity to measure likelihood of input being in a category

Zero-shot means we can give it possible category labels that the model hasn't been trained on

How likely does the input **entail a hypothesis**?

DeBERTa

- BERT: Bidirectional encoder representations from transformers
(2018, Google)
- DeBERTa: Decoding-enhanced BERT with disentangled attention
(2020-2021, Microsoft Research)
- Fine-tuned version of DeBERTa:
<https://huggingface.co/MoritzLaurer/deberta-v3-large-zeroshot-v1>

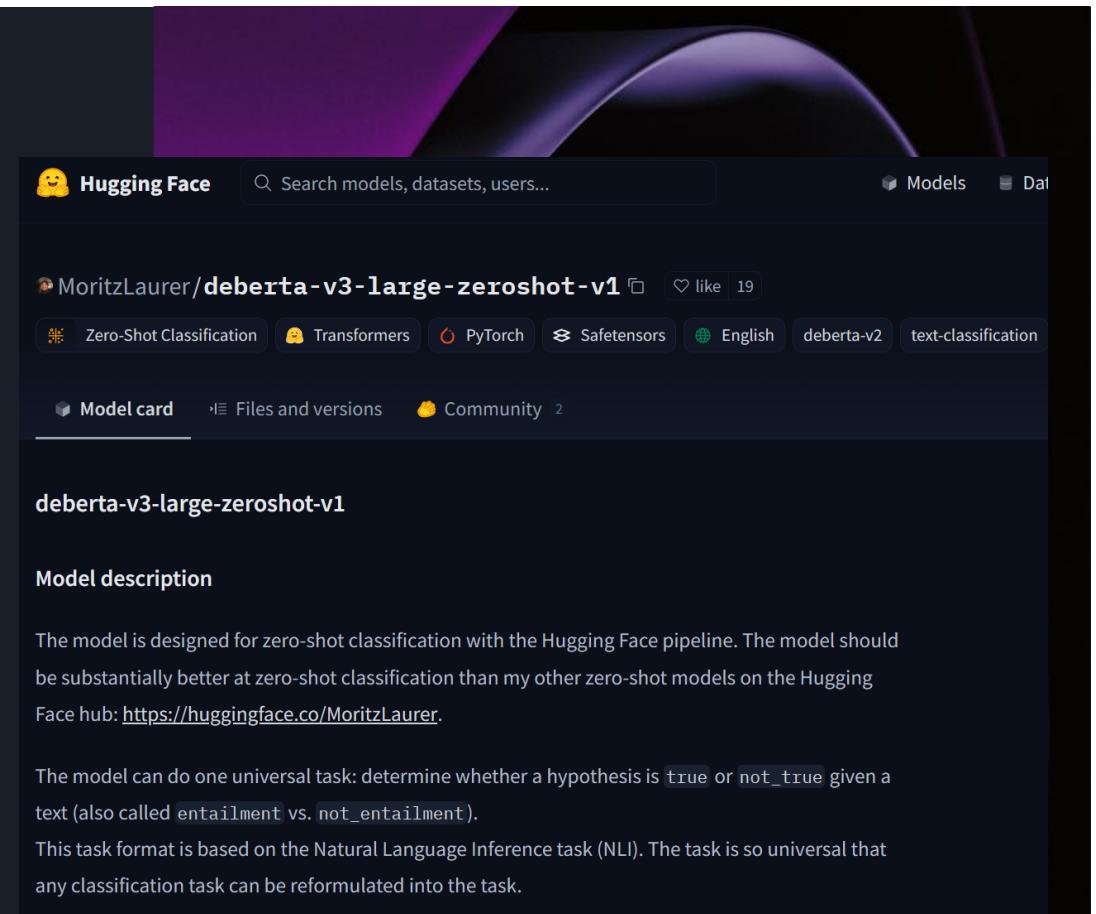
Less Annotating, More Classifying: Addressing the Data Scarcity Issue of Supervised

Machine Learning with Deep Transfer Learning and BERT-NLI

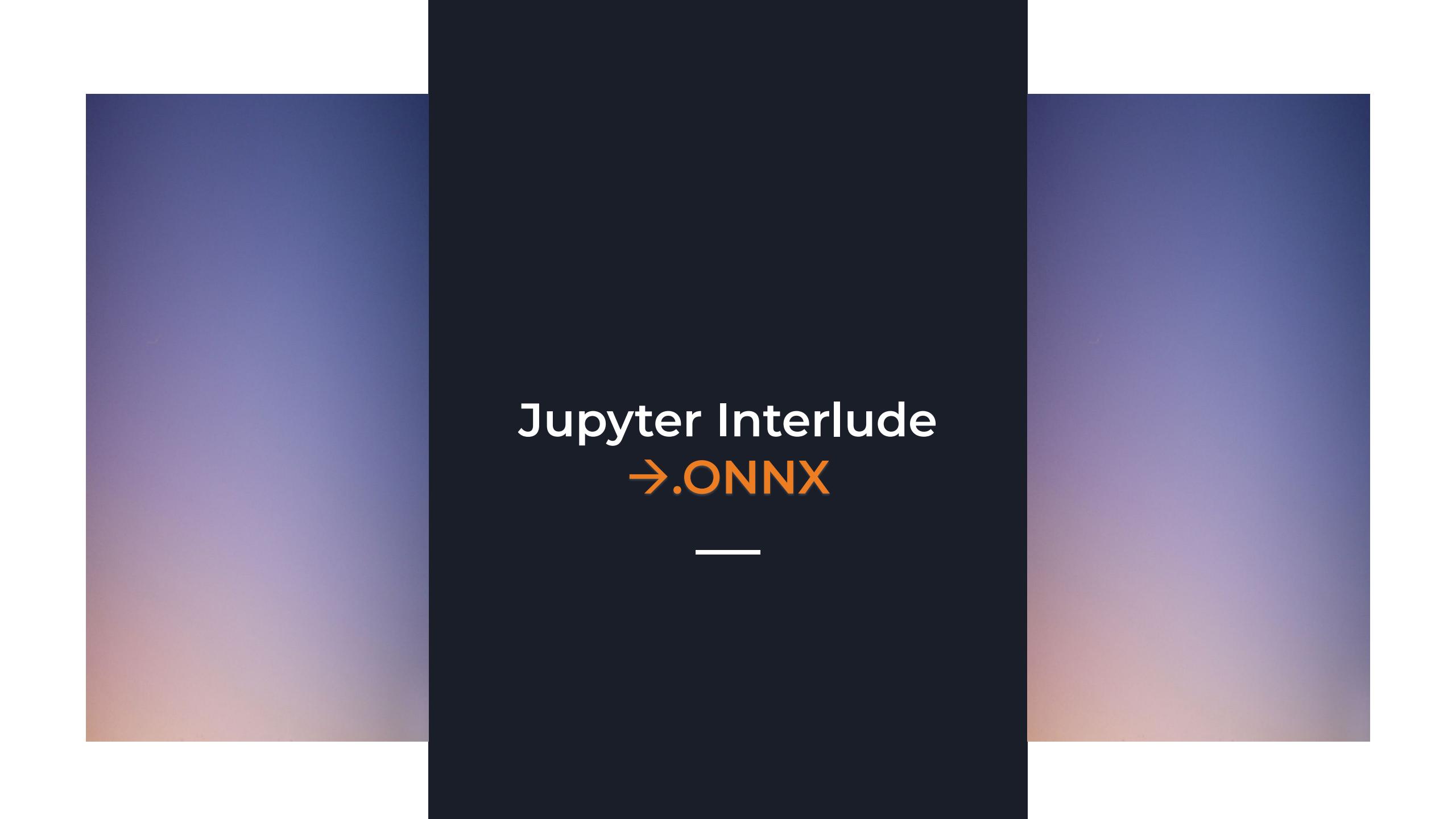
Moritz Laurer, Wouter Van Atteveldt, Andreu Casas, Kasper Welbers

Political Analysis, Cambridge University Press, 2023.

<https://doi.org/10.1017/pan.2023.20>



The screenshot shows the Hugging Face model card for `deberta-v3-large-zeroshot-v1`. The card includes the author's profile picture and name (`MoritzLaurer`), the model name, a like count of 19, and a link to the pipeline. Below the card are sections for the Model card, Files and versions, and Community. The Model description section explains the model is designed for zero-shot classification and provides a link to the Hugging Face hub. The text also describes the universal task of determining entailment or not_entailment based on NLI tasks.



Jupyter Interlude

→.ONNX

Local Pipeline

```
import json
from transformers import pipeline
classifier = pipeline("zero-shot-classification", model="MoritzLaurer/deberta-v3-large-zeroshot-v1")
sequence_to_classify = "The prime minister met with international leaders"
candidate_labels = ["weather", "entertainment", "sports", "finance", "science", "politics"]
output = classifier(sequence_to_classify, candidate_labels, multi_label=False)
print(json.dumps(output, indent=4))

| ✓ 5.4s

Device set to use cpu
{
    "sequence": "The prime minister met with international leaders",
    "labels": [
        "politics",
        "finance",
        "entertainment",
        "science",
        "sports",
        "weather"
    ],
    "scores": [
        0.998672604560852,
        0.00031738588586449623,
        0.0002589169598650187,
        0.00025301624555140734,
        0.0002507023746147752,
        0.00024740086519159377
    ]
}
```



Local Pipeline

```
import json
from transformers import pipeline
classifier = pipeline("zero-shot-classification", model="MoritzLaurer/deberta-v3-large-zeroshot-v1")
sequence_to_classify = "How many calories are in your hamburger?"
candidate_labels = [ "sales", "customer support", "technical support", "accounting", "marketing", "shipping and orders" ]
output = classifier(sequence_to_classify, candidate_labels, multi_label=False)
print(json.dumps(output, indent=4))

✓ 4.5s

Device set to use cpu
{
    "sequence": "How many calories are in your hamburger?",
    "labels": [
        "marketing",
        "accounting",
        "sales",
        "customer support",
        "technical support",
        "shipping and orders"
    ],
    "scores": [
        0.634022057056427,
        0.12989985942840576,
        0.06265775114297867,
        0.0603039376437664,
        0.06020446866750717,
        0.052911896258592606
    ]
}
```



Local ONNX + QNN EP

```
# Use the QNN (aka Qualcomm AI Engine Direct) execution provider
options = onnxruntime.SessionOptions()
session = onnxruntime.InferenceSession(model_path, sess_options=options, providers=["QNNExecutionProvider"], p

# Create hypotheses
template = "This example is {}."
hypotheses = [template.format(label) for label in candidate_labels]

# Tokenize
encoded = tokenizer(
    [text] * len(candidate_labels),
    hypotheses,
    return_tensors="np",
    truncation=True,
    padding=True
)

# Run ONNX model
logits = session.run(
    None,
    {
        "input_ids": encoded["input_ids"],
        "attention_mask": encoded["attention_mask"],
    }
)[0]

# Use entailment scores (index 0) and normalize with softmax
entailment_scores = logits[:, 0]
probs = torch.softmax(torch.from_numpy(entailment_scores), dim=0).numpy()

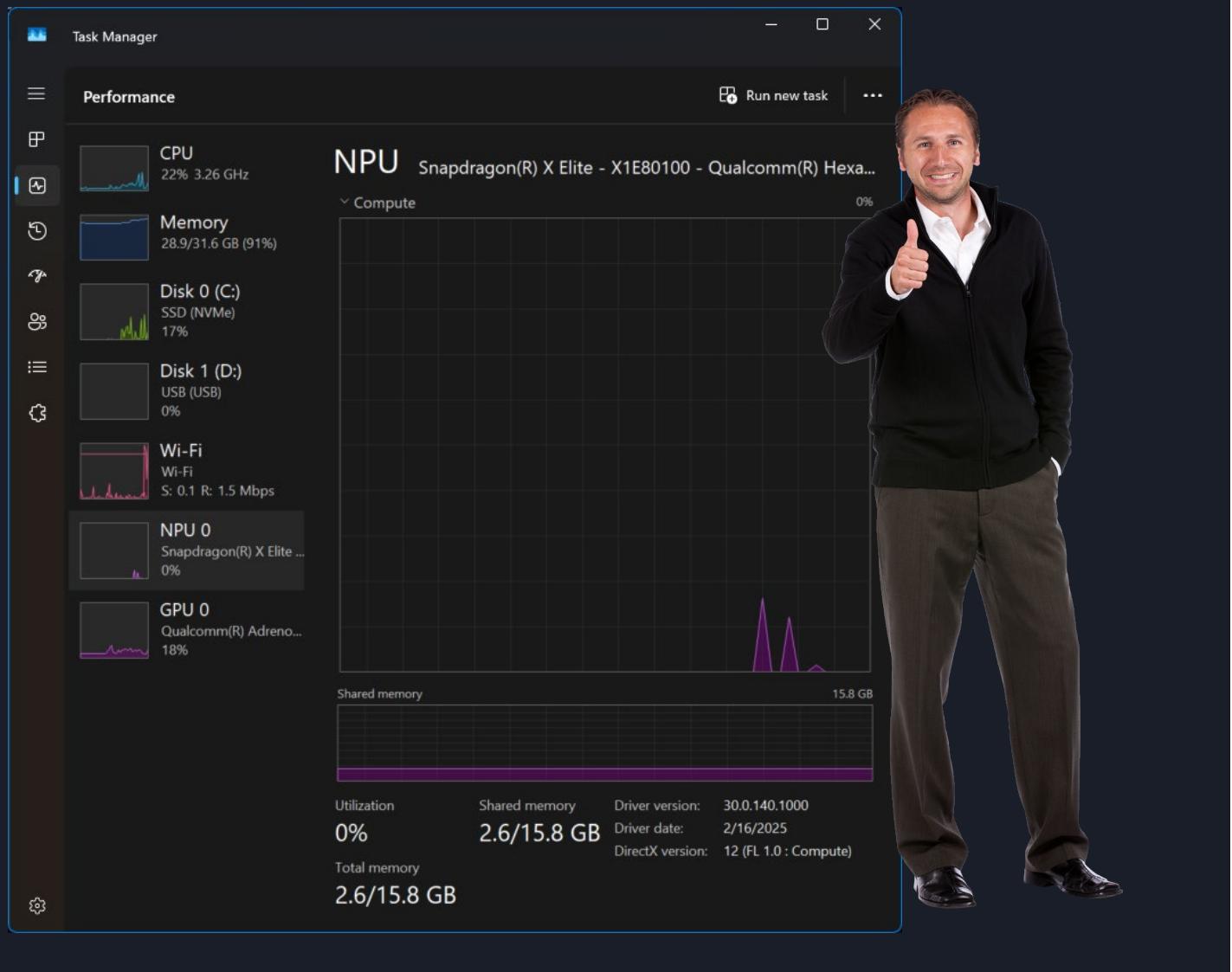
# Zip labels and scores
results = sorted(zip(candidate_labels, probs), key=lambda x: x[1], reverse=True)

# Display
for label, score in results:
    print(f"{label}: {score:.4f}")

✓ 10.5s
marketing: 0.6341
accounting: 0.1299
sales: 0.0627
customer support: 0.0603
technical support: 0.0602
shipping and orders: 0.0529
```



Local ONNX + QNN EP



Azure Interlude

Deploy ONNX in



ml.azure.com

In Azure ML

```
# Test deployment
import requests
import json

url = "https://onnxworkspace-jfass.centralus.inference.ml.azure.com/score"

data = {
    "text": "How many calories are in your hamburger?",
    "labels": [ "sales", "customer support", "technical support", "accounting", "marketing" ]
}

headers = {'Content-Type':'application/json', 'Accept': 'application/json', 'Authorization': 'Bearer ' + token}

response = requests.post(url, json=data, headers=headers)
parsed = json.loads(response.content)      # parse the JSON string

print(parsed)
```

✓ 1.8s

[["marketing", 0.6340243816375732], ["accounting", 0.12989859282970428], ["sales", 0.06265752762], ["customer support", 0.05121111111111111], ["technical support", 0.04857142857142857], [





FINAL WORDS ON ONNX

Cross-platform, but you must keep some things in mind



Tweaks may be required

You may need to tweak files for optimum execution on local or cloud: multiple options to adjust.

You may see (ideally, none, but) minuscule differences in result numbers.



Additional files

Cloud endpoint: **score.py** to tell Azure ML how to load and process data with the model (included!)

If dealing with text, may need **vocab.txt** for tokenization (included!)

YOU ARE HERE



Implement Cloud Version



Understand and Work with
an ONNX Model



Implement Evaluators



Implement Local Version



CHOOSE YOUR OWN ADVENTURE

Depending on your comfort level...



Build the app with me

Use readymade code snippets as we work through our solution



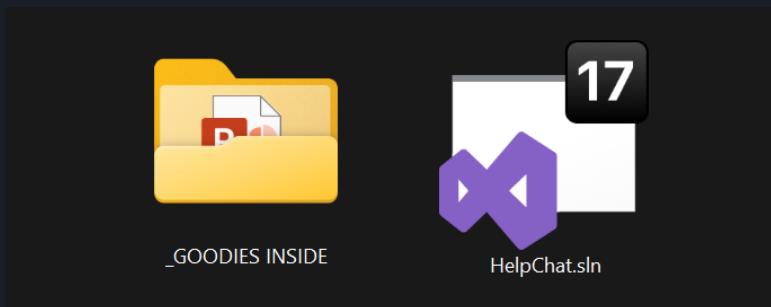
DIY

Look at the code snippets to get an idea of what we are doing, but try it unsupervised (👉 machine learning joke 😅)

(or, take the offramp to DIY once you see how it works)

GET READY

- One key folder and one key file
- Visual Studio: A quick familiarization



Files

Start Debugging

Solution Explorer

Search Solution Explorer (Ctrl+Shift+F)

Labels.cs

ChatService.cs*

```
1  using HelpChat.Models;
2  using HelpChat.Utils;
3  using Microsoft.Extensions.AI;
4  using Serilog;
5  using System;
6  using System.Collections.Generic;
7  using System.Threading;
8  using System.Threading.Tasks;
9
10 namespace HelpChat.Services;
11
12 public class ChatService
13 {
14     private readonly List<HelpChatMessage> _conversationHistory = new();
15     private readonly IChatClient _chatClient;
16     private int _maxTokens = 800;
17
18     public Microsoft.UI.Dispatching.DispatcherQueue WindowDispatcherQueue { get; init; }
19 }
```

Checkpoint: Solution and Code Open

This screenshot shows the Microsoft Visual Studio interface. At the top, the menu bar includes File, Edit, View, Git, Project, Build, Debug, Test, Analyze, Tools, Extensions, Window, Help, and a Search dropdown. The toolbar below has various icons for file operations like Open, Save, and Build. The status bar at the bottom indicates 'Labels.cs' is the active file. The main code editor displays the 'ChatService.cs' file. In the Solution Explorer on the right, a search bar is highlighted with an orange arrow. The search results show the 'HelpChat' project structure, including files like 'Labels.cs', 'vocab.txt', and 'zero_shot_classifier.onnx'. The 'Solution Explorer' tab is selected in the bottom navigation bar.

CLOUD STEPS

By the end of this slide, you should have an app that welcomes the user, gets the classifier result from the ONNX model in Azure ML, and returns a ChatGPT response.



SHOW A WELCOME MESSAGE

By the end of this step:

- Run the application
- See a generated welcome message

HANDLE SUBMITTED MESSAGES

By the end of this step:

- Type a message in the text box and submit it by pressing Enter or the send button

GET CLOUD ONNX RESULT

By the end of this step:

- See a message with the classification of the input
- View logs

GET CHATGPT RESPONSE

By the end of this step:

- Verify we are telling ChatGPT what persona (=label) to use
- See the response by ChatGPT to a message
- Try a couple variations

YOU ARE HERE



Understand and Work with
an ONNX Model



Implement Cloud Version



Implement Evaluators



Implement Local Version

WHAT ARE EVALUATORS

Deciders that tell whether to use cloud or local AI

IMPLEMENTATIONS MAY VARY

- One evaluator failing is enough to sway decision?
- Or plurality of evaluators with weights attached to each



PRIVACY

- Any data that is sensitive or personal?

CONNECTIVITY AND LATENCY

- Remote-remote workers with a spotty or non-existent connection

DEVICE RESOURCES

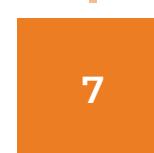
- Larger model in cloud for special cases
- Battery level

COST

- Paying subscription user?
- Ways to integrate cost-savings dynamically

EVALUATOR STEPS

By the end of this slide, you should have an evaluator system set up that knows about the user's connectivity as well as input message contents.



SET UP INTERFACE & FRAMEWORK

Nothing to see; don't run anything just yet

IMPLEMENT PRIVACY EVALUATOR

Keep holding your horses

IMPLEMENT LATENCY EVALUATOR

Almost there (but you can see if it builds, as a treat!)

PUT IT ALL TOGETHER

By the end of this step:

- We should get nothing (and not error out) if we have no connectivity or have a message with a long number in it
- Verify cloud still works, though!

YOU ARE HERE



Understand and Work with
an ONNX Model



Implement Cloud Version



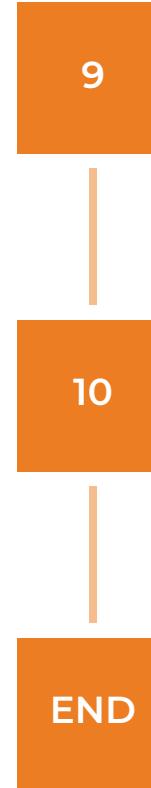
Implement Evaluators



Implement Local Version

LOCAL STEPS

By the end of this slide, you should have a complete application that decides on whether to use cloud or local AI, and generate a response appropriately.



GET LOCAL ONNX RESULT

By the end of this step:

- See a message using local classification of the input

GET PHI SILICA RESPONSE

By the end of this step:

- Get a response from Phi Silica

YOU NOW HAVE A COMPLETE APP

Congratulations!



EXTEND/ENHANCE THE SOLUTION

If there's time...

GIVE IT A WHIRL

Try the solution out with various input statements.

● ENGINEER THE PROMPTS

Play around with the prompts a bit and see if you can vary the responses that come back.

● ADD MORE EVALUATORS

Try adding one that uses local AI if it's plugged in, and cloud if it's not

● ADD CHAT HISTORY / RESET BUTTON

Right now it starts anew with each input message.

RECAP AND NEXT STEPS

Today we:

- **Converted** a Hugging Face model to ONNX
- Deployed that model in the **cloud**
- Used that same model on the **device**
- Talked with an Azure OpenAI **ChatGPT** deployment
- Talked with **Phi Silica** running on the NPU
- Implemented **evaluators** that can route AI requests to the cloud or the device, as required

THINGS THAT MAKE YOU GO “HMM”

- Do you have any AI models in the cloud that you can bring on-device?
- Do you have any AI models you can run on-device?
- What sort of evaluators would you use in your application to decide cloud vs device?

FINAL BITS



GITHUB

Complete Code
This presentation
Jupyter notebook
Score.py

<https://bit.ly/hybridailab>



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