Build a Virtual Assistant Using Jarvis, BlueXP Copy and Sync, and NeMo

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NetApp
August 15, 2023

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Overview

This section provides detail on the implementation of the virtual retail assistant.

Next: Jarvis Deployment

Jarvis Deployment

You can sign up for Jarvis Early Access program to gain access to Jarvis containers on NVIDIA GPU Cloud (NGC). After receiving credentials from NVIDIA, you can deploy Jarvis using the following steps:

1. Sign-on to NGC.
2. Set your organization on NGC: `ea-2-jarvis`.
3. Locate Jarvis EA v0.2 assets: Jarvis containers are in `Private Registry` > `Organization Containers`.
4. Select Jarvis: navigate to `Model Scripts` and click `Jarvis Quick Start`
5. Verify that all assets are working properly.
6. Find the documentation to build your own applications: PDFs can be found in `Model Scripts` > `Jarvis Documentation` > `File Browser`.

Next: Customize States and Flows for Retail Use Case

Customize States and Flows for Retail Use Case

You can customize States and Flows of Dialog Manager for your specific use cases. In our retail example, we have the following four yaml files to direct the conversation according to different intents.

Se the following list of file names and description of each file:

- `main_flow.yml`: Defines the main conversation flows and states and directs the flow to the other three yaml files when necessary.
- `retail_flow.yml`: Contains states related to retail or points-of-interest questions. The system either provides the information of the nearest store, or the price of a given item.
- `weather_flow.yml`: Contains states related to weather questions. If the location cannot be determined, the system asks a follow up question to clarify.
- `error_flow.yml`: Handles cases where user intents do not fall into the above three yaml files. After displaying an error message, the system re-routes back to accepting user questions.The following sections contain the detailed definitions for these yaml files.

main_flow.yml

```
name: JarvisRetail
intent_transitions:
```

```
  jarvis_error: error
  price_check: retail_price_check
  inventory_check: retail_inventory_check
  store_location: retail_store_location
  weather.weather: weather
  weather.temperature: temperature
  weather.sunny: sunny
  weather.cloudy: cloudy
  weather.snow: snow
  weather.rainfall: rain
  weather.snow_yes_no: snowfall
  weather.rainfall_yes_no: rainfall
  weather.temperature_yes_no: tempyesno
  weather.humidity: humidity
  weather.humidity_yes_no: humidity
  navigation.startnavigationpoi: retail # Transitions should be context
and slot based. Redirecting for now.
  navigation.geteta: retail
  navigation.showdirection: retail
  navigation.showmappoi: idk_what_you_talkin_about
  nomatch.none: idk_what_you_talkin_about
states:
  init:
    type: message_text
    properties:
      text: "Hi, welcome to NARA retail and weather service. How can I
help you?"
  input_intent:
    type: input_context
    properties:
      nlp_type: jarvis
      entities:
        intent: dontcare
# This state is executed if the intent was not understood
  dont_get_the intent:
    type: message_text_random
    properties:
      responses:
        - "Sorry I didn't get that! Please come again."
        - "I beg your pardon! Say that again?"
        - "Are we talking about weather? What would you like to know?"
        - "Sorry I know only about the weather"
        - "You can ask me about the weather, the rainfall, the
temperature, I don't know much more"
      delay: 0
    transitions:
```

```
      next_state: input_intent
  idk_what_you_talkin_about:
    type: message_text_random
    properties:
      responses:
        - "Sorry I didn't get that! Please come again."
        - "I beg your pardon! Say that again?"
        - "Are we talking about retail or weather? What would you like to
know?"
        - "Sorry I know only about retail and the weather"
        - "You can ask me about retail information or the weather, the
rainfall, the temperature. I don't know much more."
      delay: 0
    transitions:
      next_state: input_intent
  error:
    type: change_context
    properties:
        update_keys:
           intent: 'error'
    transitions:
        flow: error_flow
  retail_inventory_check:
    type: change_context
    properties:
        update_keys:
           intent: 'retail_inventory_check'
    transitions:
        flow: retail_flow
  retail_price_check:
    type: change_context
    properties:
        update_keys:
           intent: 'check_item_price'
    transitions:
        flow: retail_flow
  retail_store_location:
    type: change_context
    properties:
        update_keys:
           intent: 'find_the_store'
    transitions:
        flow: retail_flow
  weather:
    type: change_context
    properties:
```

```
      update_keys:
         intent: 'weather'
  transitions:
      flow: weather_flow
temperature:
  type: change_context
  properties:
      update_keys:
         intent: 'temperature'
  transitions:
      flow: weather_flow
rainfall:
  type: change_context
  properties:
      update_keys:
         intent: 'rainfall'
  transitions:
      flow: weather_flow
sunny:
  type: change_context
  properties:
      update_keys:
         intent: 'sunny'
  transitions:
      flow: weather_flow
cloudy:
  type: change_context
  properties:
      update_keys:
         intent: 'cloudy'
  transitions:
      flow: weather_flow
snow:
  type: change_context
  properties:
      update_keys:
         intent: 'snow'
  transitions:
      flow: weather_flow
rain:
  type: change_context
  properties:
      update_keys:
         intent: 'rain'
  transitions:
      flow: weather_flow
```

```
  snowfall:
      type: change_context
      properties:
          update_keys:
             intent: 'snowfall'
      transitions:
          flow: weather_flow
  tempyesno:
      type: change_context
      properties:
          update_keys:
             intent: 'tempyesno'
      transitions:
          flow: weather_flow
  humidity:
      type: change_context
      properties:
          update_keys:
             intent: 'humidity'
      transitions:
          flow: weather_flow
  end_state:
    type: reset
    transitions:
      next_state: init
```

retail_flow.yml

```
name: retail_flow
states:
  store_location:
    type: conditional_exists
    properties:
      key: '{{location}}'
    transitions:
      exists: retail_state
      notexists: ask_retail_location
  retail_state:
    type: Retail
    properties:
    transitions:
      next_state: output_retail
  output_retail:
      type: message_text
      properties:
```

```
      text: '{{retail_status}}'
    transitions:
      next_state: input_intent
ask_retail_location:
  type: message_text
  properties:
    text: "For which location? I can find the closest store near you."
  transitions:
    next_state: input_retail_location
input_retail_location:
  type: input_user
  properties:
    nlp_type: jarvis
    entities:
      slot: location
    require_match: true
  transitions:
    match: retail_state
    notmatch: check_retail_jarvis_error
output_retail_acknowledge:
  type: message_text_random
  properties:
    responses:
      - 'ok in {{location}}'
      - 'the store in {{location}}'
      - 'I always wanted to shop in {{location}}'
    delay: 0
  transitions:
    next_state: retail_state
output_retail_notlocation:
  type: message_text
  properties:
    text: "I did not understand the location. Can you please repeat?"
  transitions:
    next_state: input_intent
check_rerail_jarvis_error:
  type: conditional_exists
  properties:
    key: '{{jarvis_error}}'
  transitions:
    exists: show_retail_jarvis_api_error
    notexists: output_retail_notlocation
show_retail_jarvis_api_error:
  type: message_text
  properties:
    text: "I am having troubled understanding right now. Come again on
```

```
that?"
    transitions:
      next_state: input_intent
```

weather_flow.yml

```
name: weather_flow
states:
  check_weather_location:
    type: conditional_exists
    properties:
      key: '{{location}}'
    transitions:
      exists: weather_state
      notexists: ask_weather_location
  weather_state:
    type: Weather
    properties:
    transitions:
      next_state: output_weather
  output_weather:
      type: message_text
      properties:
        text: '{{weather_status}}'
      transitions:
        next_state: input_intent
  ask_weather_location:
    type: message_text
    properties:
      text: "For which location?"
    transitions:
      next_state: input_weather_location
  input_weather_location:
    type: input_user
    properties:
      nlp_type: jarvis
      entities:
        slot: location
      require_match: true
    transitions:
      match: weather_state
      notmatch: check_jarvis_error
  output_weather_acknowledge:
    type: message_text_random
    properties:
```

```
      responses:
        - 'ok in {{location}}'
        - 'the weather in {{location}}'
        - 'I always wanted to go in {{location}}'
      delay: 0
    transitions:
      next_state: weather_state
  output_weather_notlocation:
    type: message_text
    properties:
      text: "I did not understand the location, can you please repeat?"
    transitions:
      next_state: input_intent
  check_jarvis_error:
    type: conditional_exists
    properties:
      key: '{{jarvis_error}}'
    transitions:
      exists: show_jarvis_api_error
      notexists: output_weather_notlocation
  show_jarvis_api_error:
    type: message_text
    properties:
      text: "I am having troubled understanding right now. Come again on
that, else check jarvis services?"
    transitions:
      next_state: input_intent
```

error_flow.yml

```
name: error_flow
states:
  error_state:
    type: message_text_random
    properties:
      responses:
        - "Sorry I didn't get that!"
        - "Are we talking about retail or weather? What would you like to
know?"
        - "Sorry I know only about retail information or the weather"
        - "You can ask me about retail information or the weather, the
rainfall, the temperature. I don't know much more"
        - "Let's talk about retail or the weather!"
      delay: 0
    transitions:
      next_state: input_intent
```

Next: Connect to Third-Party APIs as Fulfillment Engine

Connect to Third-Party APIs as Fulfillment Engine

We connected the following third-party APIs as a Fulfillment Engine to answer questions:

- WeatherStack API: returns weather, temperature, rainfall, and snow in a given location.
- Yelp Fusion API: returns the nearest store information in a given location.
- eBay Python SDK: returns the price of a given item.

Next: NetApp Retail Assistant Demonstration

NetApp Retail Assistant Demonstration

We recorded a demonstration video of NetApp Retail Assistant (NARA).

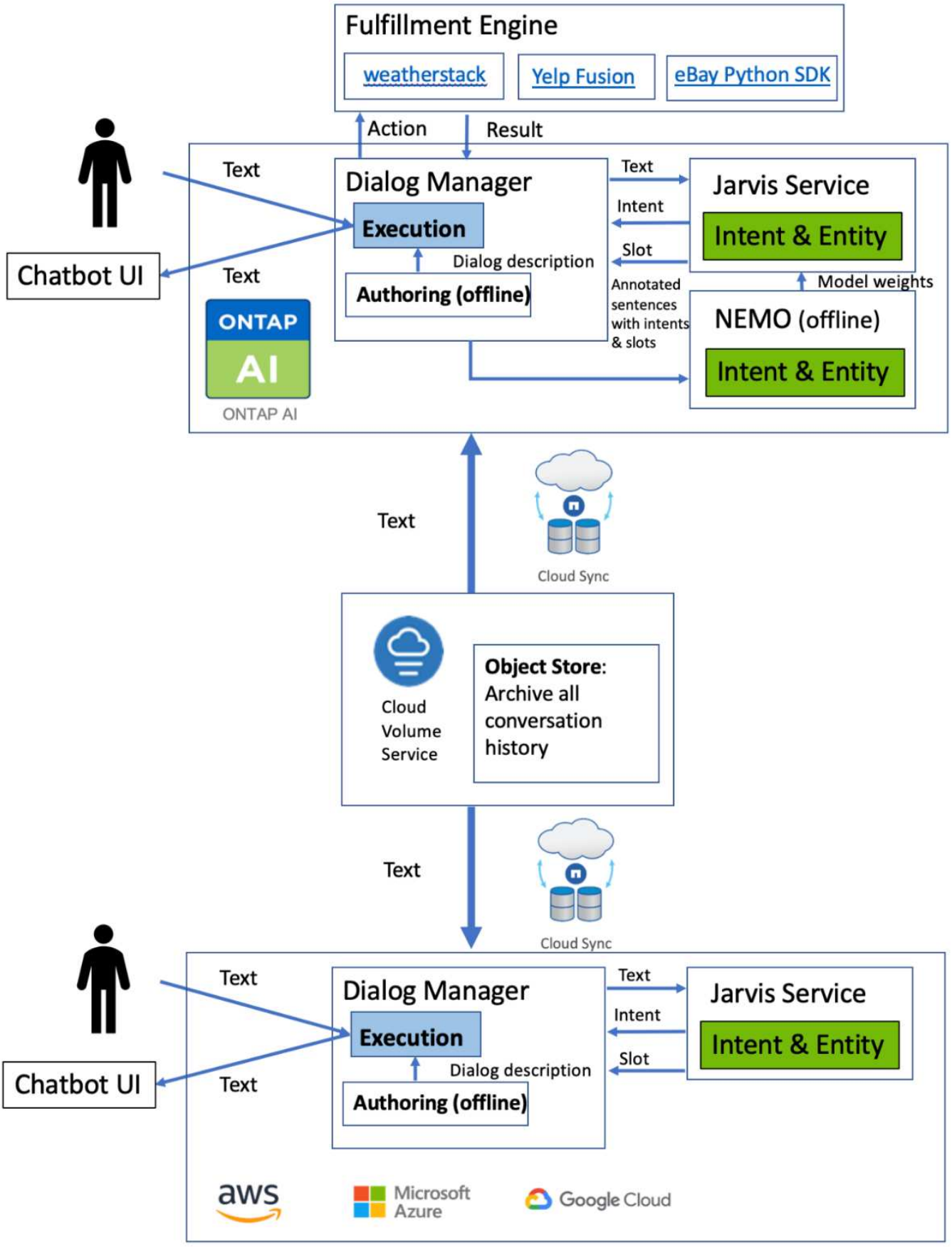
Video demonstration of NARA

Video demonstration of NARA

Next: Use NetApp BlueXP Copy and Sync to Archive Conversation History

Use NetApp BlueXP Copy and Sync to Archive Conversation History

By dumping conversation history into a CSV file once a day, we can then leverage BlueXP Copy and Sync to download the log files into local storage. The following figure shows the architecture of having Jarvis deployed on-premises and in public clouds, while using BlueXP Copy and Sync to send conversation history for NeMo training. Details of NeMo training can be found in the section Expand Intent Models Using NeMo Training.



Next: Expand Intent Models Using NeMo Training

Expand Intent Models Using NeMo Training

NVIDIA NeMo is a toolkit built by NVIDIA for creating conversational AI applications. This toolkit includes collections of pre-trained modules for ASR, NLP, and TTS, enabling researchers and data scientists to easily compose complex neural network architectures and put more focus on designing their own applications.

As shown in the previous example, NARA can only handle a limited type of question. This is because the pre-trained NLP model only trains on these types of questions. If we want to enable NARA to handle a broader range of questions, we need to retrain it with our own datasets. Thus, here, we demonstrate how we can use NeMo to extend the NLP model to satisfy the requirements. We start by converting the log collected from NARA into the format for NeMo, and then train with the dataset to enhance the NLP model.

Model

Our goal is to enable NARA to sort the items based on user preferences. For instance, we might ask NARA to suggest the highest-rated sushi restaurant or might want NARA to look up the jeans with the lowest price. To this end, we use the intent detection and slot filling model provided in NeMo as our training model. This model allows NARA to understand the intent of searching preference.

Data Preparation

To train the model, we collect the dataset for this type of question, and convert it to the NeMo format. Here, we listed the files we use to train the model.

dict.intents.csv

This file lists all the intents we want the NeMo to understand. Here, we have two primary intents and one intent only used to categorize the questions that do not fit into any of the primary intents.

```
price_check
find_the_store
unknown
```

dict.slots.csv

This file lists all the slots we can label on our training questions.

```
B-store.type
B-store.name
B-store.status
B-store.hour.start
B-store.hour.end
B-store.hour.day
B-item.type
B-item.name
B-item.color
B-item.size
```

```
B-item.quantity
B-location
B-cost.high
B-cost.average
B-cost.low
B-time.period_of_time
B-rating.high
B-rating.average
B-rating.low
B-interrogative.location
B-interrogative.manner
B-interrogative.time
B-interrogative.personal
B-interrogative
B-verb
B-article
I-store.type
I-store.name
I-store.status
I-store.hour.start
I-store.hour.end
I-store.hour.day
I-item.type
I-item.name
I-item.color
I-item.size
I-item.quantity
I-location
I-cost.high
I-cost.average
I-cost.low
I-time.period_of_time
I-rating.high
I-rating.average
I-rating.low
I-interrogative.location
I-interrogative.manner
I-interrogative.time
I-interrogative.personal
I-interrogative
I-verb
I-article
O
```

train.tsv

This is the main training dataset. Each line starts with the question following the intent category listing in the file dict.intent.csv. The label is enumerated starting from zero.

train_slots.tsv

```
20 46 24 25 6 32 6
52 52 24 6
23 52 14 40 52 25 6 32 6
…
```

Train the Model

```
docker pull nvcr.io/nvidia/nemo:v0.10
```

We then use the following command to launch the container. In this command, we limit the container to use a single GPU (GPU ID = 1) since this is a lightweight training exercise. We also map our local workspace /workspace/nemo/ to the folder inside container /nemo.

```
NV_GPU='1' docker run --runtime=nvidia -it --shm-size=16g \
                        --network=host --ulimit memlock=-1 --ulimit
stack=67108864 \
                        -v /workspace/nemo:/nemo\
                        --rm nvcr.io/nvidia/nemo:v0.10
```

Inside the container, if we want to start from the original pre-trained BERT model, we can use the following command to start the training procedure. data_dir is the argument to set up the path of the training data. work_dir allows you to configure where you want to store the checkpoint files.

```
cd examples/nlp/intent_detection_slot_tagging/
python joint_intent_slot_with_bert.py \
    --data_dir /nemo/training_data\
    --work_dir /nemo/log
```

If we have new training datasets and want to improve the previous model, we can use the following command to continue from the point we stopped. checkpoint_dir takes the path to the previous checkpoints folder.

```
cd examples/nlp/intent_detection_slot_tagging/
python joint_intent_slot_infer.py \
    --data_dir /nemo/training_data \
    --checkpoint_dir /nemo/log/2020-05-04_18-34-20/checkpoints/ \
    --eval_file_prefix test
```

Inference the Model

We need to validate the performance of the trained model after a certain number of epochs. The following command allows us to test the query one-by-one. For instance, in this command, we want to check if our model can properly identify the intention of the query `where can I get the best pasta`.

```
cd examples/nlp/intent_detection_slot_tagging/
python joint_intent_slot_infer_b1.py \
--checkpoint_dir /nemo/log/2020-05-29_23-50-58/checkpoints/ \
--query "where can i get the best pasta" \
--data_dir /nemo/training_data/ \
--num_epochs=50
```

Then, the following is the output from the inference. In the output, we can see that our trained model can properly predict the intention find_the_store, and return the keywords we are interested in. With these keywords, we enable the NARA to search for what users want and do a more precise search.

```
[NeMo I 2020-05-30 00:06:54 actions:728] Evaluating batch 0 out of 1
[NeMo I 2020-05-30 00:06:55 inference_utils:34] Query: where can i get the
best pasta
[NeMo I 2020-05-30 00:06:55 inference_utils:36] Predicted intent:       1
find_the_store
[NeMo I 2020-05-30 00:06:55 inference_utils:50] where   B-
interrogative.location
[NeMo I 2020-05-30 00:06:55 inference_utils:50] can     O
[NeMo I 2020-05-30 00:06:55 inference_utils:50] i       O
[NeMo I 2020-05-30 00:06:55 inference_utils:50] get     B-verb
[NeMo I 2020-05-30 00:06:55 inference_utils:50] the     B-article
[NeMo I 2020-05-30 00:06:55 inference_utils:50] best    B-rating.high
[NeMo I 2020-05-30 00:06:55 inference_utils:50] pasta   B-item.type
```

Next: Conclusion

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