

LAB INSTRUCTIONS

PTE – Artificial Intelligence in Practice

Abstract

The goal of this document is to guide the reader through the exercises meant to show how practical AI applications can be built based on reusable, ready-made building blocks

Norbert Sepp, Ferenc Rada, László Boa
IBM Hungary

Introduction

AI is a vast field. Getting beyond the theoretical foundations, one finds that there are many ways to put AI into practice. To rapidly prototype a solution, one can use ready-made building blocks and focus their own efforts on other aspects of the final solution, like an innovative idea or a unique feature. That approach is an efficient and valid path to success. Through these exercises you will gain practical experience with Watson solutions available on the IBM Cloud.

The access to these services is free; however, some limitations may apply.

The lab exercises are a guidance to various components. Following the instructions you will understand what each listed service is capable of, and will be informed about where to go next should you need more information.

Feel free to go deeper on your own in order to explore more capabilities, or address your questions directly to the instructors.

The lab exercise will require appx. 5 hours to complete.

You will discover the following topics:

- What is computer vision (Watson Visual Recognition)?
 - How to build your chatbot (Watson Assistant, Speech to Text, Text to Speech)?
 - What can be used to process natural-language content (Language Translator, Natural Language Classifier, Natural Language Understanding, Tone Analyzer)?
 - How can the machine assist you in understanding someone's personality traits (Personality Insights)?
 - How to connect building blocks with the least effort? (NodeRED)
- ... and probably more.

The recommended sequence of the exercises is the following. If you miss the ETA to complete one, feel free to save it for later – your environment will be available.

Contents:

1. Watson Assistant
2. Watson Visual Recognition
3. Personality Insights
4. Speech to Text and Text to Speech
5. Language APIs: Language Translator, Natural Language Understanding, Natural Language Classifier, Tone Analyzer
6. Using NodeRED

Prerequisites:

- an IBM Cloud account (registration is free)
- CURL (a free downloadable tool)
- a Jupyter notebook server (the recommended environment is the freely downloadable Anaconda Navigator)
- some understanding of programming, though thorough experience is not required

Watson Assistant

Introduction and business justification

We people are excellent chatters. We can talk about different things and understand different utterances identifying quickly and precisely what our dialogue partner means and can mobilize all our knowledge to deliver a relevant response. In a typical „assistance“ conversation the dialogue is around one topic with the goal to find a solution to the problem being addressed. But sometimes we are limited: constant availability, limited knowledge about the topic or temper being lost are just a few reasons why we are interested in making computers able to follow meaningful conversations.

Applications like guiding people through complex processes (whether a menu sytem, a product's capabilities or the maze of taxation law), acting like a knowledgable companion or an expert support person, providing a humanlike interface for vehicle control, would benefit from this kind of technology.

Chatbots (digital assistans) is an important topic. You will get your hands dirty with Watson Assistant, which is a rich chatbot-building AI service (offered as an API) available on the IBM Cloud.

The technology behind WA is partially standard algorithms that the industry offers, completed with many extra features that make this solution unique and highly valuable. The capabilities of it was made available as an easy to use service.

Exercises

1) Explore the [demo](#)

- | | |
|--------------|---|
| Navigate to: | https://cloud.ibm.com/catalog?category=ai |
| Select: | Watson Assistant |
| Click: | View docs |
| Select: | Demo: Banking Assistant |

This chatbot demonstrates a very simple assistant. There are 3 use cases that you will try: Make a Payment, Book an Appointment, Recommend a Credit Card.

Test all 3 and check the JSON output with every response. Try some strange questions like Where are you? or What is the time?

Keep the Documentation open as you will need it for the rest of the exercise.

2) Make your hands dirtier

- a) Log in to **IBM Cloud**
- b) Select **Watson Assistant** from the **Catalog / AI** category
- c) Select Dallas as Region, Lite as the Plan, and take note of the service name. Click Create.
- d) To the left, check and store (e.g. in Notepad) your service credentials for later reference. You can check them later from the Dashboard / Services.
- e) Click '**Launch Watson Assistant**'.

Read the following overview before clicking anything further

- f) First, you will create a **dialog skill**. Skills are an assistant's capabilities. Multiple skills can be attached to an assistant, and a skill can be assigned to multiple assistants.
- g) Next, you will create **Intents**. Intents are what a user wants the assistant to do. These are the activities (verbs), like *#password_reset* or *#order_food*.
- h) Then, you will define **Entities**. Entities are the target of the intents, like *@account* or *@pizza*.
- i) Finally, you will stitch together the components creating a dialog structure. This will be the control mechanism for the assistant behavior.
- j) *Note, that Watson Assistant can be a very useful and knowledgeable companion, but full capability requires thorough planning, development and test efforts. Today, you will need to understand the basics, so finer details will not be part of the exercise first run. However, you are encouraged to come back and deepen your knowledge in this area by following this and other detailed tutorials.*

And now get ready to click and type, following the recommended parts from the Docs.

You will create a simple bot for the university (PTEBot) that initially understands 3 intents:

- *location_request (for entities buffet, hostel, auditoriums, rooms and dean's office)*
- *registration for an optional course (AI for Engineers, Programming, Advanced Statistics)*
- *request for financial assistance (scholarship details, aid, financial details, student accounts)*

Try to create a simple yet useful digital assistant for students like you, who have many questions and would be grateful for a 24/7 support! To get you up to the task, you should

understand some core concepts, so read on and create the components you deem necessary.

- k) Look at the picture in *Development process*. This shows you a typical setup of the process and capabilities the environment offers.
- l) Follow *Creating an assistant*. Do **NOT** use **Search skill** – this requires a different user level. From now on, skip parts marked in Docs. as **Plus**.
- m) Follow *Creating a skill*. **Skip** *creating a search skill*. Read *Creating a dialog skill*.
- n) Use content catalogs: *Banking*, *Bot Control* and *General*.
- o) Read *Create intents* if you need guidance. Otherwise, based on your understanding of the presentation, create the intents for your PTEBot following the descriptions above.
- p) Read *creating Entities* if you need guidance. Otherwise, based on your understanding of the presentation, create the entities for your PTEBot following the descriptions above.
- q) Read *Creating a Dialog* if you need guidance. Otherwise, based on your understanding of the presentation, create the dialog for your PTEBot based on the descriptions above.
- r) *This will be the basics of an assistant. If you want to know more, here is the recommended learning path:*
 - a) *Follow Tutorial: Building a car dashboard dialog*
 - b) *Follow Tutorial: Building a complex dialog.*
 - c) *Read and follow Tutorials: Adding a node with slots / Improving a node with slots / Understanding digressions.*

Congratulations! You have created your own service component that you can use as a building block in custom AI solutions.

This concludes the exercise.

Watson Visual Recognition

Introduction and business justification

We people have an excellent sight. We can tolerate different shapes, different lighting conditions, different picture quality, blurred images, motion etc. Our vision is superb, and we base most of our decisions on things we see. But sometimes we are limited: small things, constant attention, huge number of images to process rapidly, non-visible spectrum are just a few reasons why we are interested in making computers able to see.

Applications like assistance to visually impaired people, monitoring food quality deterioration by looking at infrared images, visual surveillance in potentially harmful environments (like mining or industrial processes) would benefit from this kind of technology.

Computer Vision is an important topic. You will get your hands dirty with Watson Visual Recognition, which is an image-classification AI service (offered as an API) available on the IBM Cloud.

The technology behind WVR is standard algorithms (neural network implementations) that the industry offers. The capabilities of it was made available as an easy to access service.

Exercises

1. Explore the [demo](#)

Navigate to:	https://cloud.ibm.com/catalog?category=ai
Select:	Visual Recognition
Click:	View docs
Select:	Demo

Roll down and explore the Demo tab. Here you can select from Custom vs. Pre-trained models to the *left*. In the *middle* you see the list of available photos and the photo being analysed. To the *right* you see what labels the classifier assigned to the picture along with the confidence levels, plus the capability to peek under the hoods by checking the JSON output of the service.

- Select **Custom Models** (the triangle should point downwards). Check all the sample pictures. Check all the labels and confidence levels below **Insurance (Custom Classifier)**. Check the JSON output.

What label has the highest confidence level among these pictures?

How is it coded in JSON?

- Select **Pre Trained Models**. Check all sample images.

What label has the highest confidence level?

How is it coded in JSON?

What is the assigned Food model category and confidence?

- Once you checked the sample images it is time to check the models on real images.
- First, select 'Drop Images here or click to upload.'
- Grant access to the web camera and take a picture of yourself.

What labels did the model assign?

What are the confidence levels and the associated JSON?

What does the Explicit and Food models say?

- Get an image from a celebrity (like a politician or artist) that you know. Download the picture and upload it to WVR.

What labels (with confidence) were assigned?

Check the JSON to see more.

- Get an image from animals (recommended: cat, horse, dog, spider). Check what WVR has to say about the contents of the picture. The pretrained general model is a quite knowledgeable service. Try it with some other objects like vehicles, landscapes, instruments and food (which has its own model – check food specifically!)

What confidence levels were assigned to labels that **you** deemed most relevant?

- **Cat contest:** In the computer vision field, the understanding of what constitutes a CAT is quite deep. You have a chance to show something meaningful to the classifier if you try to draw a cat. Draw a cat and take a picture of it.

How did it perform with the classifier?

Who among you in the class drew the cat that was categorized as a cat with the highest confidence?

2. Make your hands dirtier

- d) Log in to **IBM Cloud**
- e) Select **Visual Recognition** from the Catalog / AI category.
- f) Check and take notes of the following parameters: Region, Service name (accept the offered defaults; if Dallas is offered as a region, select it)
- g) Select the Lite plan (it should be offered as a default)
- h) click **Create**. The service will be provisioned for you.
- i) Open a Notepad to take notes of your credentials (or you can come back here later – on the Cloud Dashboard, available Services can be checked for Service Credentials. You will need them later.)
- j) Follow the **Getting Started** Tutorial. Do **NOT** select Watson Studio for the graphical interface yet – we start with cURL. Be careful – at the top of the screen you can use Show Credentials – it will fill in the apikey values for you so that you can copy and paste the long commands. **Use it only once**, otherwise your API keys will be messed up. In such cases you have to refresh your page or restart the exercise.

In each task, check the image offered, use the example, then collect a similar, different image and check the results with that.

Note, that cURL is only one option to use. If you are familiar with a different offering, feel free to try that (Go, Python etc.)

- k) Select **build a custom model** and follow the tutorial. Download the zipped training images to your computer – you will need them later. Don't forget to delete your model in the end.
- l) On the top of the Getting Started page, click the **Watson Studio** button. Watson Studio is a feature-rich managed, cloud-based graphical user environment for building custom AI solutions. You will use it to build your custom model through a GUI.
- m) Watson Studio offers **Image Classification** and **Object Detection** possibilities.
- n) First, select and note your service credentials.
- o) Select **Classify Images** from the Custom Models. Click **Create Model**.
- p) Name the project Dogs1. Click **Create**. Alongside with the model environment an object storage (an IBM Cloud Service) will be automatically provisioned and connected for you. This is quite comfortable.

q) Upload the zipped images '**Beagle**', '**Husky**', '**Dalmatians**'. Respective classes will automatically be created.

r) Add '**Cats**' as negative images.

s) **Train** the model. It may take a while.

t) Once the training is completed, you can **test** your model. Obtain new testing images from the web. The model will be available in Watson Studio under Assets/models/Visual Recognition Models. Clicking the model will show you an Overview, the Test tab and the Implementation tab.

In **Overview** you can check your classes.

In Test you can drop images to test (with an assignable threshold) and check if your model performs as needed.

In **Implementation** you can access various code snippets and the coreML code.

u) One important aspect is how to improve your model. WVR offers a possibility to Edit and Retrain your model. With that, you can add new images, negative images, remove incorrect images (if not trained on yet). This is the standard way of improving a classifier.

v) Next, you will get acquainted with object detection. Go back to the Dogs1 project, and under Models, select New Visual Recognition Model / Object Detection (Beta).

w) Select '**Cats**' and drag and drop it over the Add Images segment. For saving time, eliminate some of the images (you will need around a dozen).

x) Click on a cat's image. Select Add object, draw a rectangle around an eye.

y) Assign a label: 'cateye'. Identify and draw a rectangle around all visible eyes without losing important detail and without adding too much irrelevant parts to the object. (Eliminate images deemed unuseful.)

z) Continue with the rest of the images.

aa) Train your model.

bb) Once the training is complete, upload those images that were not used for training and try auto labeling. If your previous model was good enough, auto labeling is a very handy utility.

cc) Improve your model, retrain and test. Evaluate the results.

Congratulations! You have created your own service component that you can use as a building block in custom AI solutions.

This concludes the exercise.

Personality Insights

Introduction and business justification

We people attempt to understand each others psychographic self, not only through the content of words spoken, but also through other impressions. But sometimes we are limited: we do not always pay attention and most of us are not trained to see the meaning of small details relevant in truly understanding one's needs, values and personal interest. These are just a few reasons why we are interested in making computers able to know us.

Applications like finding ideal schools for our children, matching the best applicant for their dream jobs or offering products to people that fit not only their expressed requirements but also their unarticulated needs would benefit from this kind of technology.

Psychographic understanding is an important topic. You will get your hands dirty with Watson Personality Insights, which is an AI service (offered as an API) available on the IBM Cloud.

The technology behind PI is a standard psychological approach (Big 5 method) that is scientifically well-established and sound. The capabilities of it was made available as an easy to access service.

Exercises

1. Explore the [demo](#)

Navigate to:	https://cloud.ibm.com/catalog?category=ai
Select:	Personality insights
Click:	View docs
Select:	Demo / Quick demo

The [Big5 \(FFM or OCEAN](#) model) personality traits is one of the most widely used and accepted psychographic tools.

At Tweets and Replies, select a tile. Click **Analyze**. Read the summary. To the right, the most descriptive personality traits are explained with everyday terms.

Familiarize yourself with **Personality**, **Needs** and **Values**.

Make a guess and then check the analysis: between the Pope and Oprah, who is more conscientious? Who has a bigger emotional range?

Check the **JSON** output. Check the **sunburst visualization**.

In Body of Text, try the provided texts and analyse the persons. Also, download excerpts from an official speech (like the [Inaugural Address](#)) and analyse. (Note: An official speech is meant to deliver a designed personality and may significantly differ from the real person.)

If you have a Twitter account, you can provide your handle and ask Watson to analyze you! Check it.

There are some fancy applications of Personality Insights. Try [Your Celebrity Match](#),

2. Make your hands dirtier

- a. Log in to **IBM Cloud**
- b. Select **Personality Insights** from the **Catalog / AI** category
- c. Select Dallas as Region, Lite as the Plan, and take note of the service name.
Click **Create**.
- d. To the left, check and store (e.g. in Notepad) your service credentials for later reference. You can check them later from the Dashboard / Services.
- e. Go through the Getting Started Tutorial. (Use Show credentials – only ONCE!)
- f. Read and research relevant terms and definitions based on your demand.

Congratulations! You have created your own service component that you can use as a building block in custom AI solutions.

This concludes the exercise.

Speech to Text and Text to Speech

Introduction and business justification

We people can talk and hear easily. We can tolerate different speakers, various pitches, languages, background noise, different directions, disturbing soundovers etc. We can speak fluently with various speed, tone, expressing even emotions. Our hearing and speech is superb, and we use speech and hearing to deliver important messages through sounds. But sometimes we are limited: constant availability, uninterrupted attention, a number of conversations to process simultaneously are just a few reasons why we are interested in making computers able to hear and speak.

Applications like accessing computer services through voice commands (like Echo, Siri, Cortana), listening to the computer guidance (like in onboard navigation systems) or making a reservation through a call (like Duplex) benefit from this kind of technology which is an important HCI (Human-Computer Interface) component in many AI applications.

STT and TTS are important topics. You will experience Watson Speech to Text and Text to Speech, which are AI services (offered as an API) available on the IBM Cloud.

The technology behind STT and TTS are standard algorithms (neural network implementations) that the industry offers plus options for valuable customization, like language customization in STT to handle domain-specific language or dialects, as well as expressing emotions in TTS. The capabilities of the services were made available as easy to access services.

Exercises

1. Explore the demos

Navigate to:	https://cloud.ibm.com/catalog?category=ai
Select:	Speech to Text
Click:	View docs
Select:	Demo / Quick demo

This service creates a detailed transcript with timecode tagging and keyword checking. It is also capable of multiple speaker identification. The end results depend on the audio quality.

Try the provided samples: first, play Sample 1 fully.

Check Text / Word timing and Alternatives / Keyword and JSON.

Note, that:

- speakers were identified, and transcript was corrected real-time
- alternatives are evaluated with confidence metrics
- keywords were spotted and timecode-tagged
- JSON is long and complex.

Try using a different voice model.

Try Sample2, play it fully.

Make observations about where it failed to identify speakers or transcribe speech. What can be the reason?

You can test the solution with your own recordings using the record function or uploading an audio file that you recorded on your phone (e.g. from Reporter app.)

Go back to the Catalog / AI selection.

Select:	Text to Speech
Click:	View docs
Select:	Demo / Quick demo

This demo shows Watson's voice synthesis capabilities. There are a few supported languages and for each language, several voices. V3 enhanced dnn voices (using deep neural nets) are improved, more natural-sounding versions.

Use the sample text to check different voices. Compare languages and compare the traditional vs the '**V3 dnn**' models.

Next, use the first provided model, '**en-US Allison**' with expressive, transformable voices.

(Expressive voice is an attempt to incorporate emotion expressions into voice synthesis.)

Test the provided SSML tags with your own, custom text. For more SSML tags, check the [relevant parts of the Documentation](#).

Test transformation SSML to change the characteristics of the voice: try glottal tension, breathiness, timbre and other parameters. For possible values, check the [Documentation](#)

Use your own text in your mothertongue to find out how to mimic your national sounds using english Voice synthesis.

Note: The voice Watson was using during the Jeopardy! quiz show is available here: check Michael, en-US.

Note: When the speech is finished, the audio is available for download as an mp3 file.

2. Make your hands dirtier

- a. Log in to IBM Cloud**
- b. Select **Speech to Text** from the **Catalog / AI** category**
- c. Select Dallas as Region, Lite as the Plan, and take note of the service name.**
Click **Create**.
- d. To the left, check and store (e.g. in Notepad) your service credentials for later reference. You can check them later from the Dashboard / Services.**
- e. Go through the Getting Started Tutorial. (Use Show credentials – only ONCE!)**
- f. Go back to the **Catalog / AI** category and select Text to Speech.**
- g. Select Dallas as Region, Lite as the Plan, and take note of the service name.**
Click **Create**.
- h. To the left, check and store (e.g. in Notepad) your service credentials for later reference. You can check them later from the Dashboard / Services.**
- i. Go through the Getting Started Tutorial. (Use Show credentials – only ONCE!)**
- j. Try using different settings.**

Congratulations! You have created your own service component that you can use as a building block in custom AI solutions.

This concludes the exercise.

Language APIs: Language Translator, Natural Language Understanding, Natural Language Classifier, Tone Analyzer

Introduction and business justification

We people are amazing language processors. We can learn different languages, use different utterances, understand prose, poetry or colloquial terms, jokes, metaphors, can invent enigmas, speak eloquently or ambiguously, and can even decode official language. But sometimes we are limited: constant attention, constant availability or the sheer volume of text content to process rapidly are just a few reasons why we are interested in making computers able to understand the content they read.

Applications like summarizing the abstract for an article, reading latest research to indicate what is related to our specified interest, recommending conflicting, pro and con arguments for a debatable question, finding the best treatment option for a cancer patient based on domain expertise and published research, assisting people in a foreign language environment to avoid completely being lost, alerting the digital service agent when the client is losing patience would benefit from this kind of technology.

Natural Language Processing is an important topic. You will get your hands dirty with NLP components, which are AI services (offered as APIs) available on the IBM Cloud.

The technology behind NLP are standard and proprietary algorithms (neural network implementations and rule-based solutions) that the industry offers. The capabilities of them were made available as easy to access services.

Exercises

1. Explore the demos

Navigate to:	https://cloud.ibm.com/catalog?category=ai
Repeat for:	Language Translator Natural Language Understanding Natural Language Classifier Tone Analyzer
Select:	the respective service

Click:	View docs
Select:	Demo

Here are some guides and questions to help you get deeper into the values of the services.

Translator

- Enter some words in a supported language without selecting the language. Let watson identify the language by itself. This is called language identification and is a prerequisite capability for multi-language translation. Test it with different languages.
- Enter and translate a sentence to a language you speak well, from Hemingway's 'The old man and the sea.' (available online at Project Gutenberg, Canada (<https://gutenberg.ca/ebooks/>)). Surprisingly good quality, right?
- Try the service with your mothertongue if supported. Use usual terms and usual utterances; poetry is typically beyond machine translation.

NLU

- Use the provided sample text. Click on **Analyze**. Check each category.
- What is the targeted sentiment for desert?
- What are the entities with highest confidence?
- What is the POS for the fourth word?
- make experiments with a different text (e.g. 'The Old Man and the Sea').

NLC

- Use the provided sample example. Try different utterances that the description claims as being out-of-training-sample. Record phrases, assigned categories and confidence levels.
- What worked and what did not?

TA

There are two demos: **General purpose** and **Customer engagement**.

- In General Purpose, check and Analyze the category Email.
- What are the Document Level Tones?
- Check Sentence level tones. What is the highest range for Anger?

- Switch to the Customer Endpoint demo. Read the conversation. You can help Watson understand us humans by giving a thumbs up/down feedback about its assessment of Tones.
- Use the Reply field playing one speaker or the other. Pay attention how Watson manages to assess the Tone used. Try moderate and more extreme examples, but avoid explicit language.

2. Make your hands dirtier

- Log in to IBM Cloud**
- Based on your needs, provision a service using the same method as previously, primarily by following the **Getting Started** tutorial. The first recommended attempt would be **Tone Analyzer**.
- The second one would be **Language Translator**.
- Go through the **Getting Started** tutorial for **LT**.
- Check Translating documents (Beta).
- What are the supported languages? What language models are available for Italian, Spanish and Korean?
- For NLU and NLC you can skip this part for the moment, returning to this task on demand.

Congratulations! You have familiarized with the service components that you can use as a building block in custom AI solutions.

This concludes the exercise.

Using Node-RED

Introduction and business justification

We people are good in creating systems of components. The Watson APIs offered are building blocks, but the integration of such components offer a leverage.

Most applications are built connecting more than one service. The know-how of making them work in concert is valuable and sometimes requires expertise from many fields. To alleviate the task, a graphical, node-based solution is offered that can be used to easily and quickly build prototypes by wiring components together, thereby letting you focus only on what is really needed.

Integrating components is an important skill. You will get your hands dirty with Node-RED, which is a node-based composition tool available as free download, or as a consumable solution on the IBM Cloud.

The technology behind Node-RED was created by IBM and later donated to the OpenJS Foundation. The capabilities were made available as an easy to access service.

Exercises

1. Visit the homepage of Node-RED and follow the [two tutorials](https://nodered.org/docs/tutorials/):

<https://nodered.org/docs/tutorials/>

2. Make your hands dirtier

- a. Follow the [initial exercise](https://ibmcode-staging.us-east.containers.mybluemix.net/tutorials/build-universal-translator-nodered-watson-ai-services/) for NodeRED at <https://ibmcode-staging.us-east.containers.mybluemix.net/tutorials/build-universal-translator-nodered-watson-ai-services/>
- b. If you are familiar with step a., make experiments wiring the components together and include Watson Assistant in the loop. The full functionality delivers better results if your assistant has improved capabilities.
- c. Note1. This exercise shows you how to use NodeRed for your services to be connected. Note2. *Other services can be consumed and included by means of cloud functions. The detailed description is beyond the scope of these instructions.*

Congratulations! You have created your own prototype AI solution. This concludes the exercise.

Bonus Content (from research.ibm.com)

[Paint with AI](#)

[What can you see?](#)

[Fool the bank](#)

[Explore the news](#)

[Classify with a Quantum Computer](#)

Conclusion

Following the guides showed you that the available services can be used as a rich capability set of useful building blocks.

Feel free experimenting with them and use them to quickly build prototypes; when you successfully put together a working solution, you can fine-tune it and scale it to your business needs.

You will find additional services on the IBM Cloud so that you can make full-fledged applications that are secure, scalable, reliable and affordable. This is an enterprise-grade cloud suitable for all sizes of solutions.