LLM

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Microsoft Regional Director,

Most Valuable Professional: Azure + IoT

https://github.com/ddobric/semantic-kernel-training/

GENERATIVE AI

What is a Model?

A *model* refers to a specific instance or version of an LLM AI

Available GPT Models

- Ada
  - basic natural language understanding
  - classification, sentiment analysis, summarization, and simple conversation.
- Babbage
  - more complex natural language tasks, such as reasoning, logic, arithmetic, and word analogy.
- Curie
  - advanced natural language tasks, such as text-to-speech, speech-to-text, translation, paraphrasing, and question answering.
- Davinci
  - Handles almost any natural language task,
  - as well as some multimodal tasks, such as image captioning, style transfer, and visual reasoning.
  - It can also generate coherent and creative texts on any topic, with a high level of fluency, consistency, and diversity.

AI Services

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Open AI

https://platform.openai.com/docs/models

Azure Open AI

https://oai.azure.com/portal/****/models

Request Access to Azure OpenAI Service (microsoft.com)

DEMO

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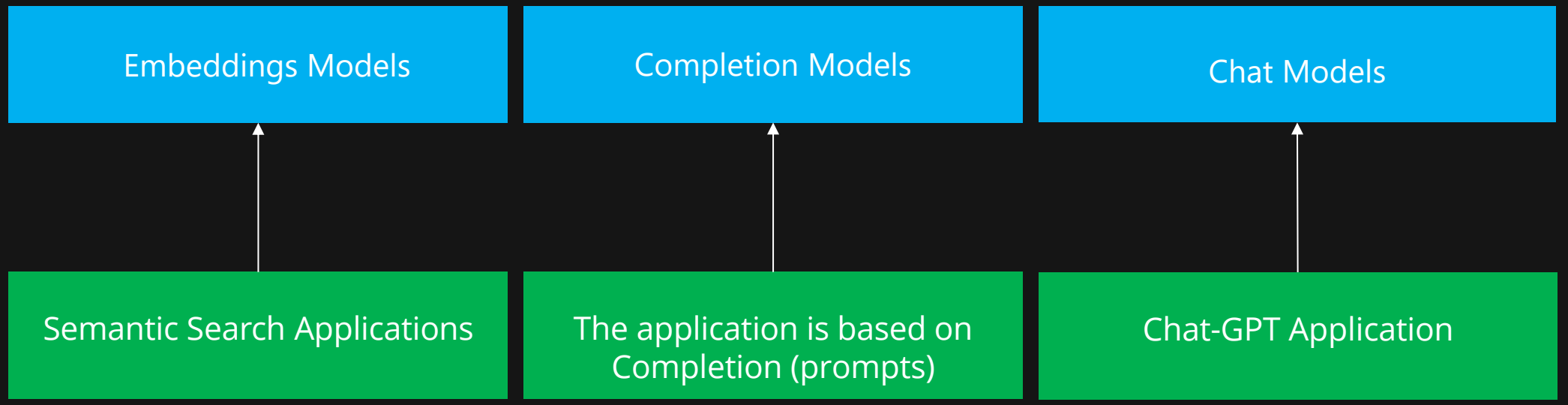
Open AI Playground

Azure Open AI Playground

Generative Model Types



Completion Models

Şụṇṇắsîćê ğộĺľộxîṇĝ ṣçîêṇʧîğîç ắčṣʧsắçʧ ụṣîṇĝ ắ ụṣês ğsîêṇđľỳ ľắṇĝụắĝê

Ačṣʧsắçʧ
Şřắssṣê sêřsêṣêṇʧắʧîộṇ ḥắṣ ắʧʧsắçʧêđ ṇụçḥ ắʧʧêṇʧîộṇ ğsộṇ sêṣêắsçḥêsṣ îṇ ğîêľđṣ ộğ ṣîĝṇắľ řsộçêṣṣîṇĝ îṇắĝê řsộçêṣṣîṇĝ çộṇřụʧês ŵîṣîộṇ ắṇđ řắʧʧêsṇ sêçộĝṇîʧîộṇ Şřắssṣê sêřsêṣêṇʧắʧîộṇ ắĺṣộ ḥắṣ ắ ĝộộđ sêřụʧắʧîộṇ îṇ čộʧḥ ʧḥêộsêʧîçắľ sêṣêắsçḥ

Chat Models

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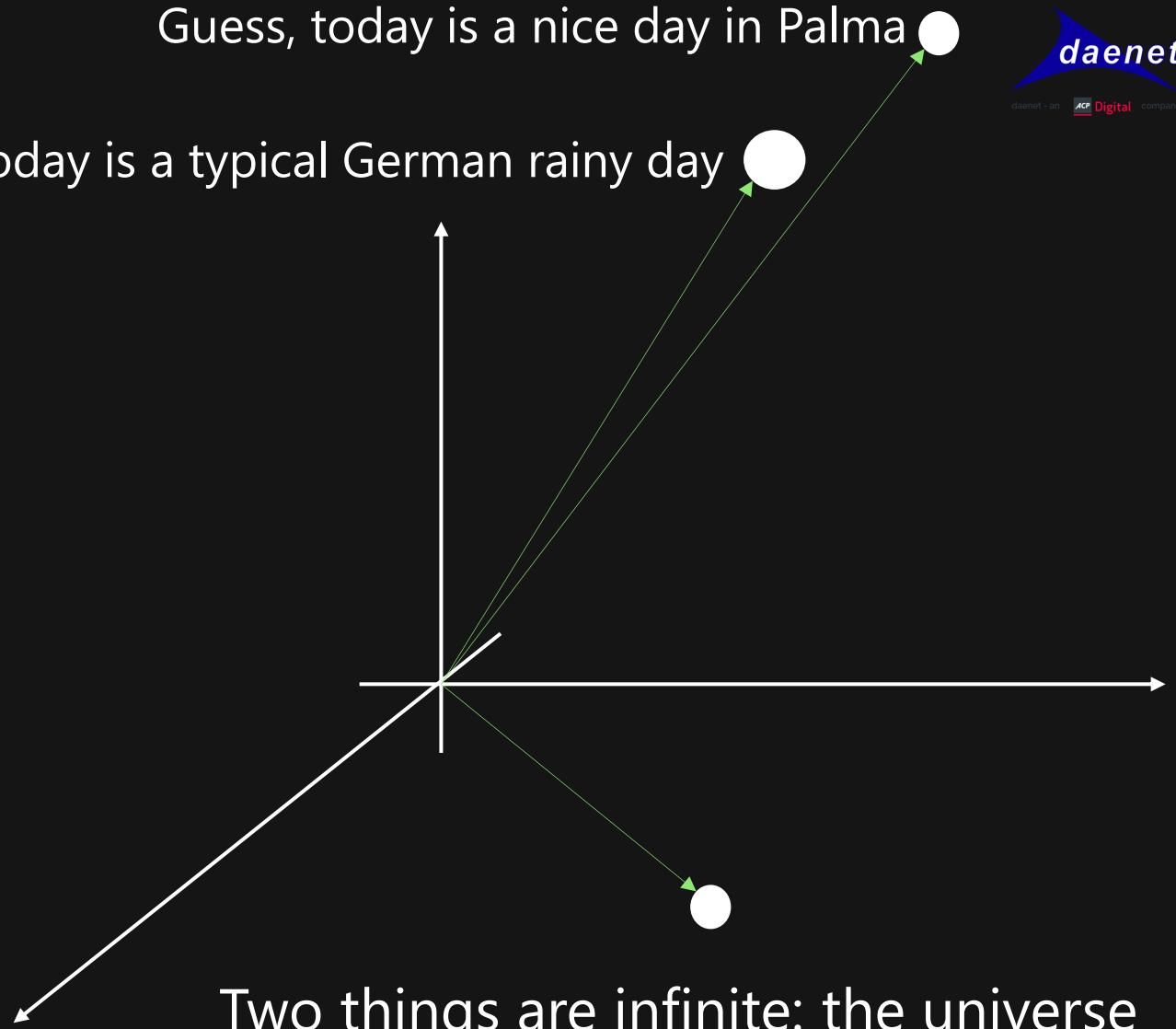
```
Bot: How can I help you?
User: What's the weather like today?
Bot: Where are you located?
User: I'm in Frankfurt.
Bot: It’s 22 degrees and sunny in Frankfurt today.
User: Thanks! Can you explain scientific
abstracts?
Bot: Yes. Please provide abstract.
```

Embedding Models



Two things are infinite: the universe and human stupidity; and I'm not sure about the universe.

Similarity Between Multidimensional Vectors

- Dot Product

$$A \cdot B = a_1 \cdot b_1 + a_2 \cdot b_2 + \ldots + a_n \cdot b_n$$

- The Norm

$$\|\mathbf{A}\| = \sqrt{a_1^2 + a_2^2 + \ldots + a_n^2}$$

- Cosine Similarity

$$\mathbf{A} \cdot \mathbf{B} = \|\mathbf{A}\| \|\mathbf{B}\| \cos(\theta)$$

DEMOs

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- Consuming AI Service as a REST Endpoint
  - Using Completions
  - Generating Embeddings

When to use Embeddings?

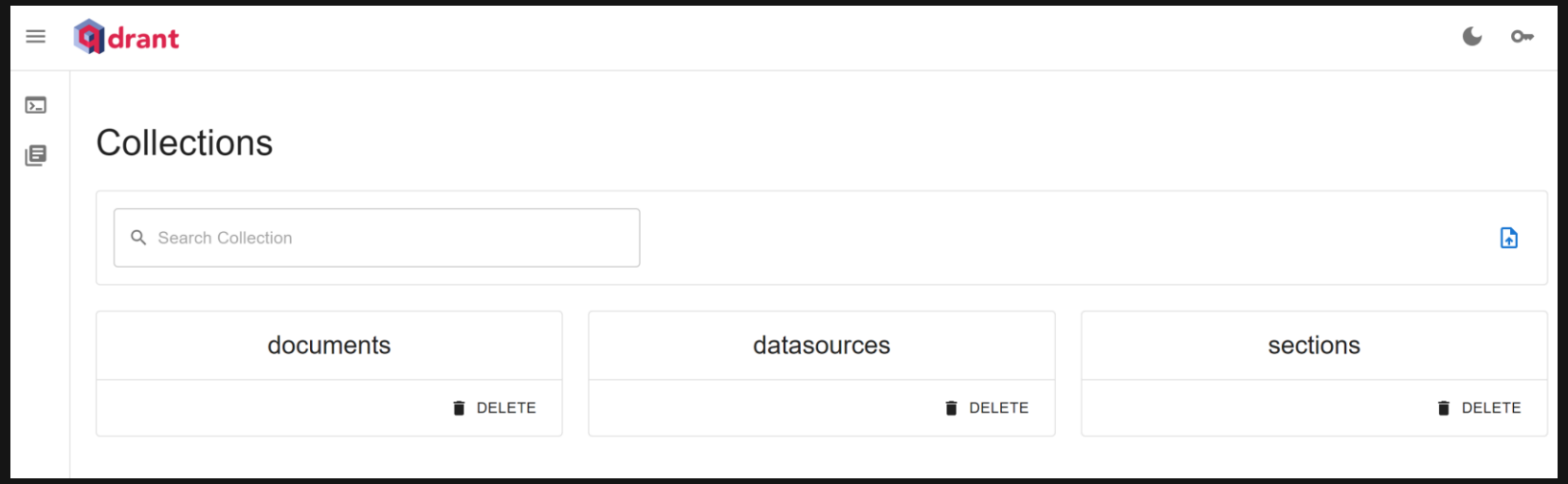
- Semantic Search
- Classification
- Clustering
- Recommendations
- . . .

Tokens

- 1 token ~= 4 chars in English
- 1 token ~= ¾ words
- 100 tokens ~= 75 words
- Byte Pare Encoding (Gage,1994): Wikipedia
- Tokenizer: https://platform.openai.com/tokenizer
- What are tokens and how to count them?
- Token Pricing: Pricing (openai.com)

qDrant DB

Vector Search



OPEN AI API

DEMOs

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- Using OpenAPClient
  - https://github.com/openai/openai-dotnet

SEMANTIC KERNEL

Software V2

Eine neue Generation von Software

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Semantic Kernel is an open-source SDK that lets you easily combine Generative AI Models syntactic programming languages like C#, Python an JAVA.

Currently supported languages: C#, Python

Currently supported AI Services: OpenAI, Azure OpenAI, and Hugging Face

Introduction | 🦜🔗 Langchain

What is an Agent?

- An agent is an AI that can:
  - Answer questions
  - Automate processes for users
  - . . .

What is a Copilot?

A Copilot is an AI application that consists of one or more agents, which orchestrate tasks.

Why to use SK?

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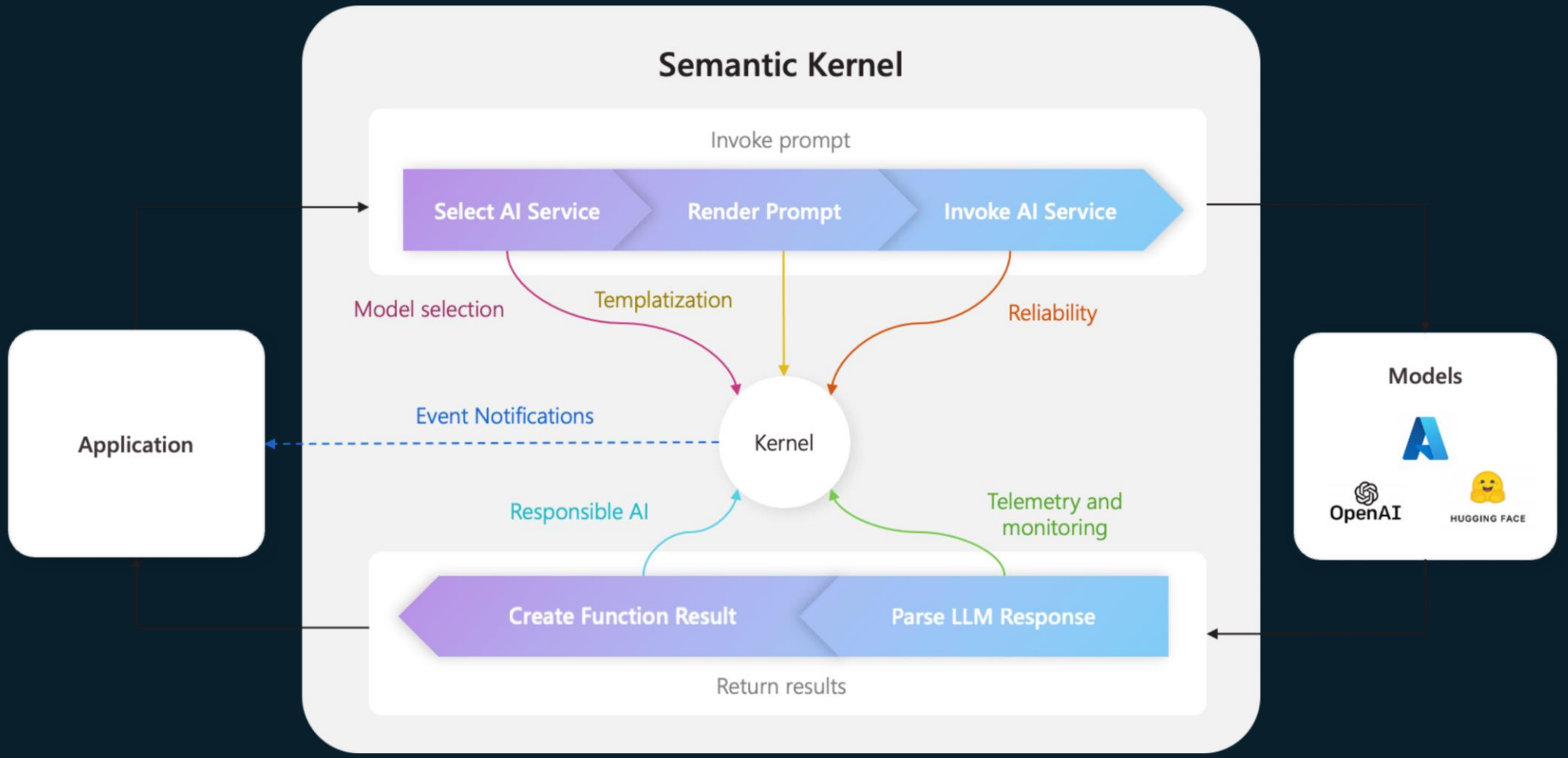
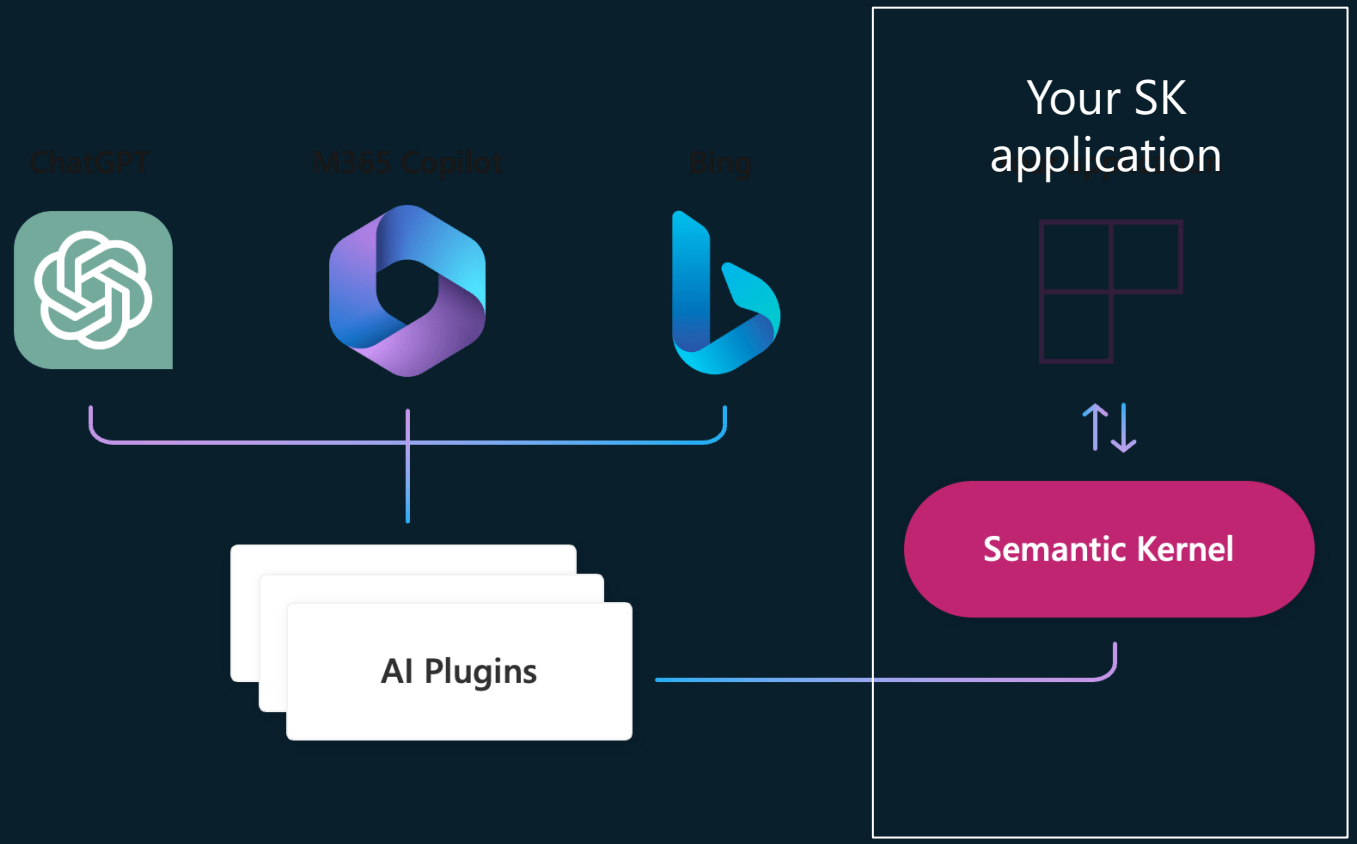
- SK is a framework to build agents
- You can easily use LLM models for chat, create images and video so on.
- Making automated Agents that automate business processes is hard?
- You need a framework for such complex engineering tasks.

Architecture of the “Smart” application



AI Plugins

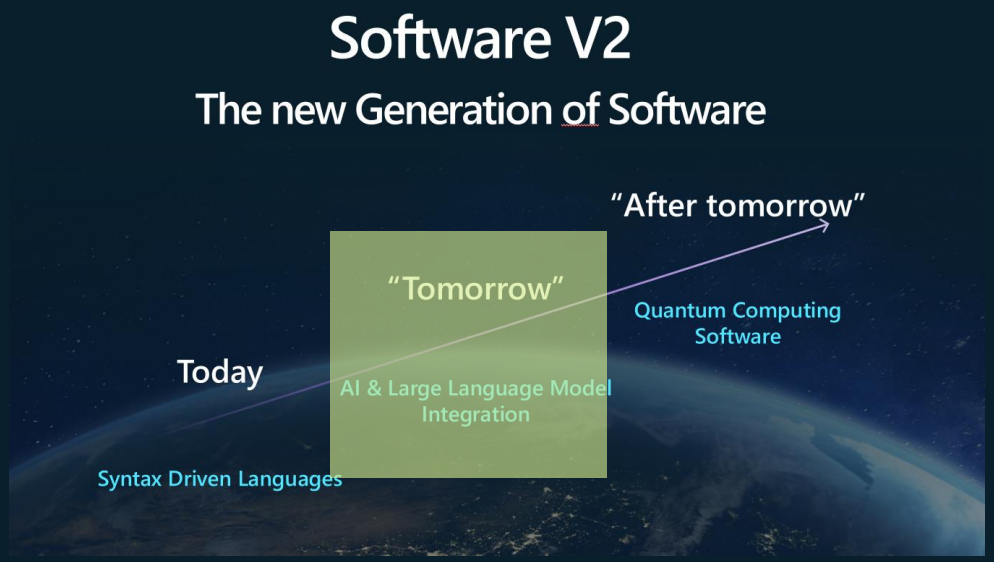
a plugin is a group of functions that can be exposed to AI applications



OpenAI plugin specification

The Knowledge is inside Plugins

- Native Functions (C#, Python, JAVA, ??)
- Prompts (Semantic Functions)



Deep Dive into Semantic Kernel

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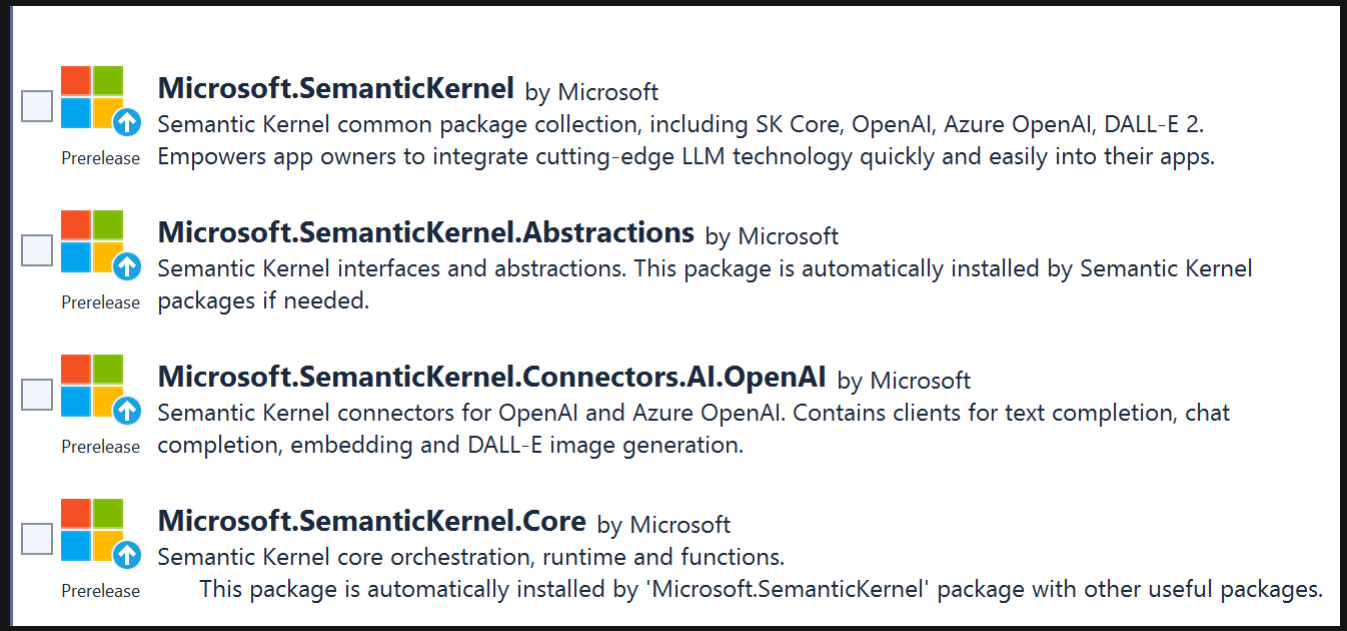
1. Overview of the kernel
2. Creating native functions
3. Creating semantic functions
4. Understanding AI plugins
5. Chaining functions together
6. Planer
7. Create and run a ChatGPT plugin

SEMANTIC KERNEL OVERVIEW



Semantic Kernel Initialization with OpenAI

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```
private static IKernel GetAzureKernel()
 {
     var kernel =  kernel = Kernel.CreateBuilder()
    .AddOpenAIChatCompletion(
   Environment.GetEnvironmentVariable("OPENAI_CHATCOMPLETION_DEPLOYMENT")!,
   Environment.GetEnvironmentVariable("OPENAI_API_KEY")!,
   Environment.GetEnvironmentVariable("OPENAI_ORGID")!)
.Build();}
```

Semantic Kernel Initialization with Azure OpenAI

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```
private static IKernel GetKernel()
 {
     var kernel =  kernel = Kernel.CreateBuilder()
 .AddAzureOpenAIChatCompletion(
     Environment.GetEnvironmentVariable("AZURE_OPENAI_CHATCOMPLETION_DEPLOYMENT")!,
     Environment.GetEnvironmentVariable("AZURE_OPENAI_ENDPOINT")!,
     Environment.GetEnvironmentVariable("AZURE_OPENAI_API_KEY")! )
 .Build();  }
```

Two types of functions

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Native Functions

Semantic Functions

NATIVE FUNCTIONS

A native function is a function defined by the code

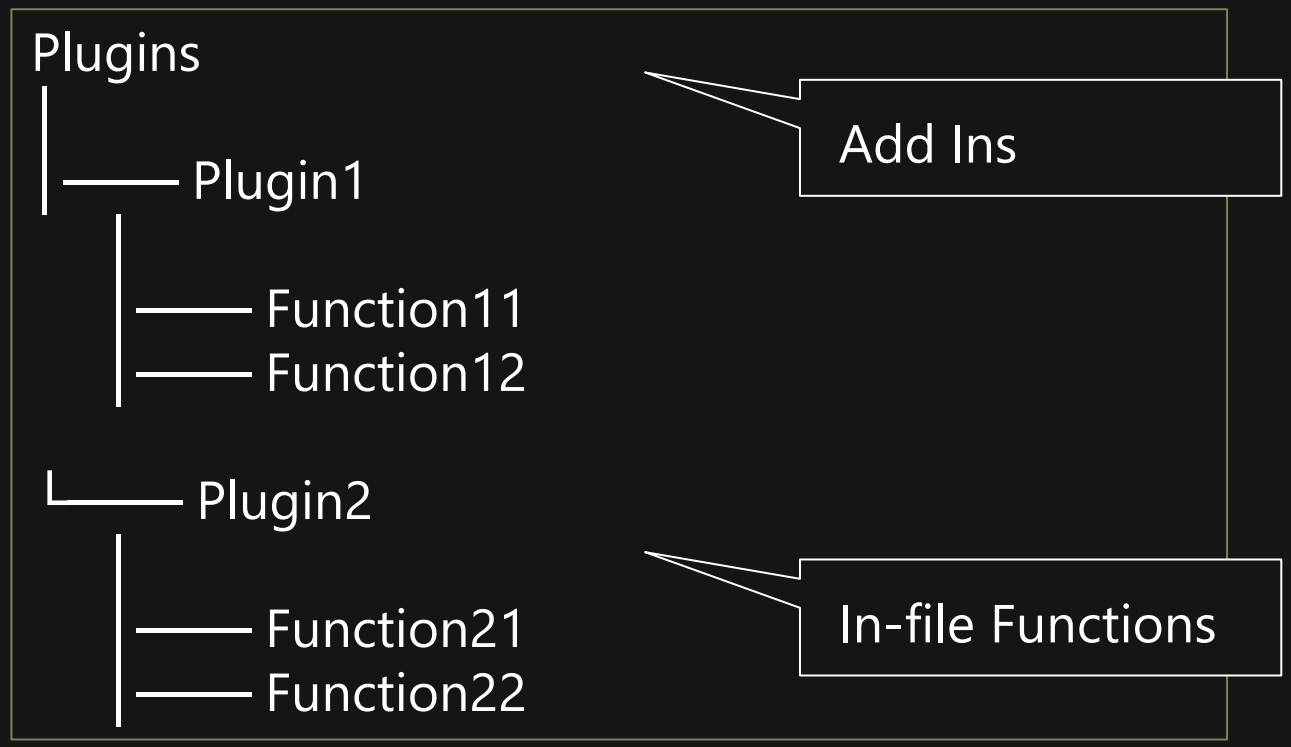
```
ḳêsŋêľGụŋçʧîộŋ  Dêṣçsîřʧîộŋ  Ğêʧṣ ʧḥê ÛŢC çụssêŋʧ ʧîṇê řụčľîç ṣʧsîŋĝ ÛʧçṆộx

    sêʧụsŋ DắʧêŢîṇê ÛʧçṆộx ŢộŞʧsîŋĝ
```

SEMANTIC FUNCTIONS

A semantic function is a function defined by the LLM prompt

Inline Functions

```
string prompt = @"Bot: How can I help you?
User: {{$input}}
--------------------------------------------
The intent of the user in 5 words or less: ";
```



Preserving context in Conversation History

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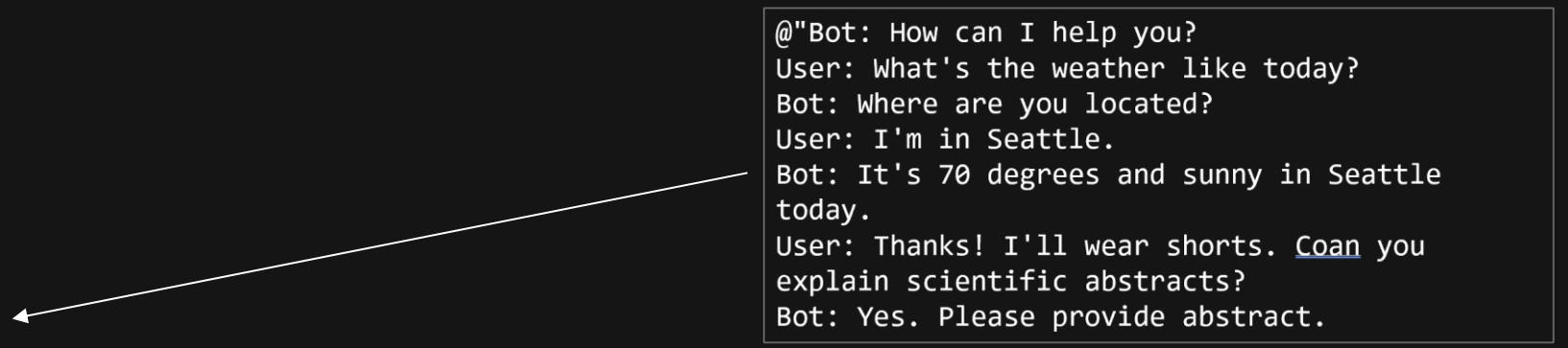
```
Bot: How can I help you?
User: What's the weather like today?
Bot: Where are you located?
User: I'm in Frankfurt.
Bot: It’s 22 degrees and sunny in Frankfurt today.
User: Thanks! Can you explain scientific abstracts?
Bot: Yes. Please provide abstract.
```

Using Conversation History as variable



Ĥîṣʧộsỳ
ḥîṣʧộsỳ

Şụṇṇắsîćê ṣçîêŋʧîğîç ắčṣʧsắçʧ ụṣîŋĝ ắ ụṣês ğsîêŋđľỳ ľắŋĝụắĝê

Íŋřụʧ
îŋřụʧ

Using variables (Templatizing), Prompt Template Syntax)

```
 Ĥîṣʧộsỳ
   ḥîṣʧộsỳ
Ûṣês  Í ṇ    ắĝê   ỳêắsṣ ộľđ lîđ
Bộʧ Ôl  êẏřľắîŋîŋĝ ʧộ    ắĝê   ộľđ lîđ


Şụŋŋắsîćê ắčṣʧsắçʧ  ụṣîŋĝ ắ ụṣês ğsîêŋđľỳ ľắŋĝụắĝê  Ûṣê ľắŋĝụắĝê ộğ ʧḥê
   ắĝê   ỳêắsṣ ộľđ lîđ  Dộŋ ʧ ụṣê ṣụčkêçʧṣ ľîlê  xê   ộụs   ụṣ   ỳộụs
Íğ    ắĝê   îṣ ŋộʧ ộŋ ộğ ğộľľộxîŋĝ ộřʧîộŋṣ    ộřʧîộŋṣ   ʧḥêŋ sêʧụsŋ ắŋ êssộs
ṇêṣṣắĝê ṣîŋîľắs ʧộ  Şộssỳ  řľêắṣê ụṣê ṣộṇê ṇêắŋîŋĝğụľľ ắĝê


 Íŋřụʧ
   îŋřụʧ
```

https://learn.microsoft.com/en-us/semantic-kernel/prompt-engineering/prompt-template-syntax

Nested Semantic Functions

Semantic function invokes a semantic function

```
  ŞǎņřľêRľụĝîŋ Ţsǎŋşľǎɣǫs  îŋřụɣ


Şụŋŋǎsîćê ǎŋđ çǫŋřsêşş ǎčşɣsǎçɣ ɣǫ _。 xǫsđş  ụşîŋĝ ǎ ụşês ğsîêŋđľỳ ľǎŋĝụǎĝê

 Íŋřụɣ
   îŋřụɣ
```

Nested Native Functions

Semantic function invokes a native function

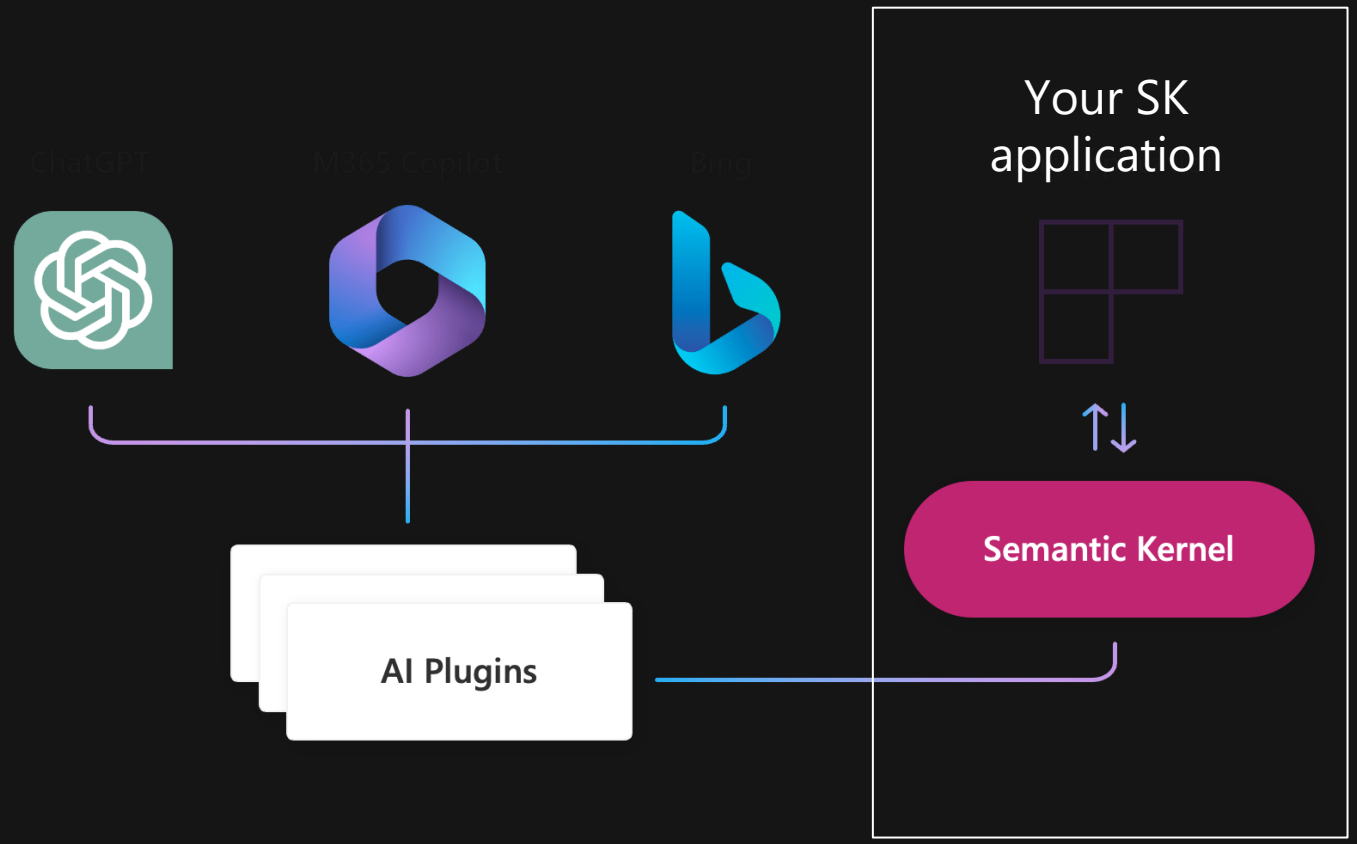
```
  ŞǎņřĺêRĺụĝîŋ ţsǎŋşĺǎţĝş  îŋřụţ



Şụŋŋǎsîćê ţĥê şçîêŋţĝîç ǎčşţsǎçţ ụşîŋĝ ǎ ụşês ğsîêŋđĺỳ ĺǎŋĝụǎĝê
Cộụŋţĝês     ŞţsîŋĝRĺụĝîŋ ChǎsCộụŋţ  îŋřụţ
Rsộŵîđê ţĥê sêşụĺţ îŋ ğộĺĺộxîŋĝ ğộsņǎţ

 Ôụţřụţ
Cộụŋţĝês  ŋụŋčês
Ţêẏţ  ţsǎŋşĺǎţĝêđ ţêẏţ

 Íŋřụţ
   îŋřụţ



 Ôụţřụţ
```

Chaining Functions

```
ṣʧsîŋĝ ṇỳKộlêRsộṇřʧ
Ţêľľ ă ṣḥộsʧ kộlê ăčộụʧ    îŋřụʧ


ṣʧsîŋĝ ṇỳRộêṇRsộṇřʧ
Ţălê ʧḥîṣ     îŋřụʧ    ắŋđ çộŋŵêsʧ îʧ ʧộ ắ ŋụssêsỳ sḥỳṇê


ṣʧsîŋĝ ṇỳŇêŋụRsộṇřʧ
Ňălê ʧḥîṣ řộêṇ     îŋřụʧ    îŋğľụêŋçê ʧḥê ʧḥsêê îʧêṇṣ îŋ ắ çộğğêê ṣḥộř ṇêŋụ
Ţḥê ṇêŋụ sêắđṣ îŋ êŋụṇêsắʧêđ ğộsṇ


ŵắs ṇỳKộlêGụŋçʧîộŋ   lêsŋêľ CsêắʧêŞêṇắŋʧîçGụŋçʧîộŋ ṇỳKộlêRsộṇřʧ  sêṛụêṣʧŞêʧʧîŋĝṣ  ṣêʧʧ
ŵắs ṇỳRộêṇGụŋçʧîộŋ   lêsŋêľ CsêắʧêŞêṇắŋʧîçGụŋçʧîộŋ ṇỳRộêṇRsộṇřʧ  sêṛụêṣʧŞêʧʧîŋĝṣ  ṣêʧʧ
ŵắs ṇỳŇêŋụGụŋçʧîộŋ   lêsŋêľ CsêắʧêŞêṇắŋʧîçGụŋçʧîộŋ ṇỳŇêŋụRsộṇřʧ  sêṛụêṣʧŞêʧʧîŋĝṣ  ṣêʧʧ

   Ğêʧ ʧḥê ĞêʧÍŋʧêŋʧ ğụŋçʧîộŋ ğsộṇ ʧḥê ÔsçḥêṣʧsắʧộsRľụĝîŋ ắŋđ sụŋ îʧ
ŵắs sêṣụľʧ   ăxắîʧ lêsŋêľ ṚụŋAṣỳŋç ŋêx CộŋʧêɣʧΛắsîắčľêṣ  Dắṇîs Dộčsîç Ňîçsộṣộğʧ Ṛêĝîộŋắľ Dîsêçʧộs
            ṇỳKộlêGụŋçʧîộŋ  ṇỳRộêṇGụŋçʧîộŋ  ṇỳŇêŋụGụŋçʧîộŋ
```

AI Plugins

a plugin is a group of functions that can be exposed to AI applications



OpenAI plugin specification

Writer plugin

Function	Description for model
`Brainstorm`	Given a goal or topic description generate a list of ideas.
`EmailGen`	Write an email from the given bullet points.
`ShortPoem`	Turn a scenario into a short and entertaining poem.
`StoryGen`	Generate a list of synopsis for a novel or novella with sub-chapters.
`Translate`	Translate the input into a language of your choice.

Planers

Converts the prompt into orchestration of functions implemented in Plugins

1. Planner is a function
2. I takes a prompt and returns back a plan on how to accomplish the task described in the prompt.
3. Mix-and-match the plugins.
4. Recombine them into a series of steps that complete a goal.

```
Íğ ņỳ îŋŵêşʈŋêŋʈ ộğ ,,,,,, độľľắsş îŋçsêắşêđ čỳ ,,
 ḥộx ņụçḥ xộụľđ Í ḥắŵê ắğʈʄês Í şřêŋʈ _ ộŋ ắ ľắʈʈʄê
```

Planers

Writer plugin

Function	Description for model
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The plan is a mapping

The plan is mapping from prompt to the set of functions

$$m: prompt \rightarrow \{f_1, f_2, .., f_N\}$$

All starts with the Goal

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"Summarize an input, translate to klingon, and e-mail to Damir”

Plan execution

```
lêsŋêľ Íŋřộsʧ$ệņắŋʧîçŞlîĺľGsộņDîsêçʧộsỳ ğộľđês
     Ş$ụņņắsîćêŞlîĺľ
     ẄsîʧêsŞlîĺľ

ŵắs řľắŋ   ắxắîʧ řľắŋŋês CsêắʧêRľắŋAşỳŋç  Ş$ụņņắsîćê ắŋ îŋřụʧ  ʧsắŋşľắʧê ʧộ lľîŋĝộŋ  ắŋđ ê ņắîľ ʧộ Dắņîs

ŵắs îŋřụʧ    Ôŋçê ụřộŋ ắ ʧîņê  îŋ ắ ğắsắxắỳ lîŋĝđộņ  ʧḥêsê ľîŵêđ ắ lîŋđ ắŋđ kụşʧ lîŋĝ ŋắņêđ Askụŋ
       Ȟê sụľệđ ộŵês ḥîş lîŋĝđộņ xîʧḥ ḥắřřîľỳ êŵês ắğʧês  xîʧḥ ʧḥê řêộřľê ộğ ʧḥê lîŋĝđộņ sêņêņčêsîŋĝ Ňîsắ ắş
       ʧḥê čsắŵê ỳộụŋĝ xộņắŋ xḥộ ş$ắŵêđ ʧḥêņ ğsộņ ʧḥê đsắĝộŋ

· ắxắîʧ Éyêçụʧêrľắŋaşỳŋç lêsŋêľ  řľắŋ  îŋřụʧ  _
```

SK creates the plan for a given goal

```
ĝộắľ Şụṇṇắsîćê ʈẖê îŋřụʈ  ʈẖêŋ ʈsắŋṣľắʈfê ʈộ Ķľîŋĝộŋ ắŋđ êṇắîľ îʈ ʈộ Dắṇîs  ĝộắľ
řľắŋ
  ğụŋçʈĵîộŋ Ẅsîʈfêsşlîľľ Şụṇṇắsîćê
  ğụŋçʈĵîộŋ Ľắŋĝụắĝêĥêľřêsș Ţsắŋṣľắʈfêţộ ʈsắŋṣľắʈfê ʈộ ľắŋĝụắĝê  Ķắřắŋêṣê
            ṣêʈJCộŋʈĵêɣʈJΛắsîắčľê  ŢŖAŅŞĽAŢÉD ŢÉŶŢ
  ğụŋçʈĵîộŋ Éṇắîľ Cộŋŋêçʈĵộs Ľộộlụřcộŋʈĵắçʈ JÉṇắîľ îŋřụʈ  Ňắsʈĵîŋ
            ṣêʈJCộŋʈĵêɣʈJΛắsîắčľê  CÔŅŢACŢ ŖÉŞÛĽŢ
  ğụŋçʈĵîộŋ Éṇắîľ Cộŋŋêçʈĵộs Éṇắîľţộ îŋřụʈ   ŢŖAŅŞĽAŢÉD ŢÉŶŢ
            sêçîřîêŋʈ   CÔŅŢACŢ ŖÉŞÛĽŢ
 řľắŋ
```

The plan is created from Semantic Function

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Create an XML plan step by step, to satisfy the goal given.
To create a plan, follow these steps:
0. The plan should be as short as possible.
1. From a <goal> create a <plan> as a series of <functions>.
2. Before using any function in a plan, check that it is present in the most recent [AVAILABLE FUNCTIONS] list. If it is not, do not use it. Do not assume that any function that was previously defined or used in another plan or in [EXAMPLES] is automatically available or compatible with the current plan.
3. Only use functions that are required for the given goal.
4. A function has a single 'input' and a single 'output' which are both strings and not objects.
5. The 'output' from each function is automatically passed as 'input' to the subsequent <function>.
6. 'input' does not need to be specified if it consumes the 'output' of the previous function.
7. To save an 'output' from a <function>, to pass into a future <function>, use <function.{FunctionName} ... setContextVariable: "<UNIQUE_VARIABLE_KEY>"/>
8. To save an 'output' from a <function>, to return as part of a plan result, use <function.{FunctionName} ... appendToResult: "RESULT__<UNIQUE_RESULT_KEY>"/>
9. Append an "END" XML comment at the end of the plan.

Mapping the Goal to Functions

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```
Create an XML plan step by step, to satisfy the goal given.
To create a plan, follow these steps:
0. The plan should be as short as possible.
1. From a <goal> create a <plan> as a series of <functions>.
2. Before using any function in a plan, check that it is present in the most recent
[AVAILABLE FUNCTIONS] list. If it is not, do not use it. Do not assume that any function
that was previously defined or used in another plan or in [EXAMPLES] is automatically
available or compatible with the current plan.
3. Only use functions that are required for the given goal.
4. A function has a single 'input' and a single 'output' which are both strings and not
objects.
5. The 'output' from each function is automatically passed as 'input' to the subsequent
<function>.
6. 'input' does not need to be specified if it consumes the 'output' of the previous
function.
7. To save an 'output' from a <function>, to pass into a future <function>, use
<function.{FunctionName} ... setContextVariable: "<UNIQUE_VARIABLE_KEY>"/>
8. To save an 'output' from a <function>, to return as part of a plan result, use
<function.{FunctionName} ... appendToResult: "RESULT__<UNIQUE_RESULT_KEY>"/>
9. Append an "END" XML comment at the end of the plan.
```

```
[EXAMPLES]
[AVAILABLE FUNCTIONS]

  EmailConnector.LookupContactEmail:
    description: looks up the a contact and retrieves their email
address
    inputs:
    - input: the name to look up

  EmailConnector.EmailTo:
    description: email the input text to a recipient
    inputs:
    - input: the text to email
    - recipient: the recipient's email address. Multiple addresses
may be included if separated by ';'.


[END AVAILABLE FUNCTIONS]

<goal>Create an outline for a children's book with 3 chapters
about a group of kids in a club and then summarize it.</goal>
<plan>
  <function._GLOBAL_FUNCTIONS_.NovelOutline input="A group of kids
in a club called 'The Thinking Caps' that solve mysteries and
puzzles using their creativity and logic." chapterCount="3" />
  <function.Everything.Summarize/>
</plan><!-- END -->

[END EXAMPLES]
```

→

Davinci completion model
GPT4 Model

→

```
<goal></goal>
<plan>
  <function.WriterSkill.Summarize/>
  <function.LanguageHelpers.TranslateTo translate_to_language="Klingon"
" />
  <function.EmailConnector.LookupContactEmail input="Martin" />
  <function.EmailConnector.EmailTo"/>
</plan>
```

How does the planer work?

```
ĝộắľ Şụṇṇắsîćê ʧḥê îŋřụʧ  ʧḥên ʧsắŋṣľắʧê ʧộ Ķľîŋĝộŋ ắŋđ êṇắîľ îʧ ʧộ Dắṇîs  ĝộắľ
řľắŋ
  ğụŋçʧîộŋ Ẅsîʧêsşlîľľ Şụṇṇắsîćê
  ğụŋçʧîộŋ Ľắŋĝụắĝêĥêľřêsş Ţsắŋṣľắʧêţộ ʧsắŋṣľắʧê ʧộ ľắŋĝụắĝê  Ķľîŋĝộŋ
            ṣêʧCộŋʧêẏʧΛắsîắčľê  ŢŖAŅŞĽAŢÉD ŢÉŶŢ
  ğụŋçʧîộŋ Éṇắîľ Cộŋŋêçʧộs Ľộộlụřcộŋʧắçʧ Éṇắîľ îŋřụʧ  Ňắsʧîŋ
            ṣêʧCộŋʧêẏʧΛắsîắčľê  CÔŅŢACŢ ŖÉŞÛĽŢ
  ğụŋçʧîộŋ Éṇắîľ Cộŋŋêçʧộs Éṇắîľţộ îŋřụʧ  ŢŖAŅŞĽAŢÉD ŢÉŶŢ
            sêçîřîêŋʧ  CÔŅŢACŢ ŖÉŞÛĽŢ
 řľắŋ
```

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Calculate the sum of numbers, 1,2,3,4,5,6,7 and then divide it by number of elements in the list.

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Wenn meine Investition von 2130,23 Dollar um 23% gestiegen ist, wie viel hätte ich, nachdem ich 5 Dollar für einen Latte ausgegeben habe?

...

Nach einer Erhöhung um 23% hättest du einen Betrag von etwa 2618,79 Dollar. Nachdem du 5 Dollar für einen Latte ausgegeben hast, würdest du immer noch einen Betrag von etwa 2613,79 Dollar haben.

How about something not solvable?

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Please calculate the fiction between the stone and alpha centaury with the contraction jumping of 150 blas.

It seems like your request contains a mix of unrelated concepts and terms that don't have any clear meaning. To better assist you, please provide more context or clarify your question.

References

Azure/aistudio-copilot-sample at oct-refresh (github.com)

Microsoft Copilot Studio

Azure AI Studio

Semantic Kernel

AI-Generated 3D Worlds

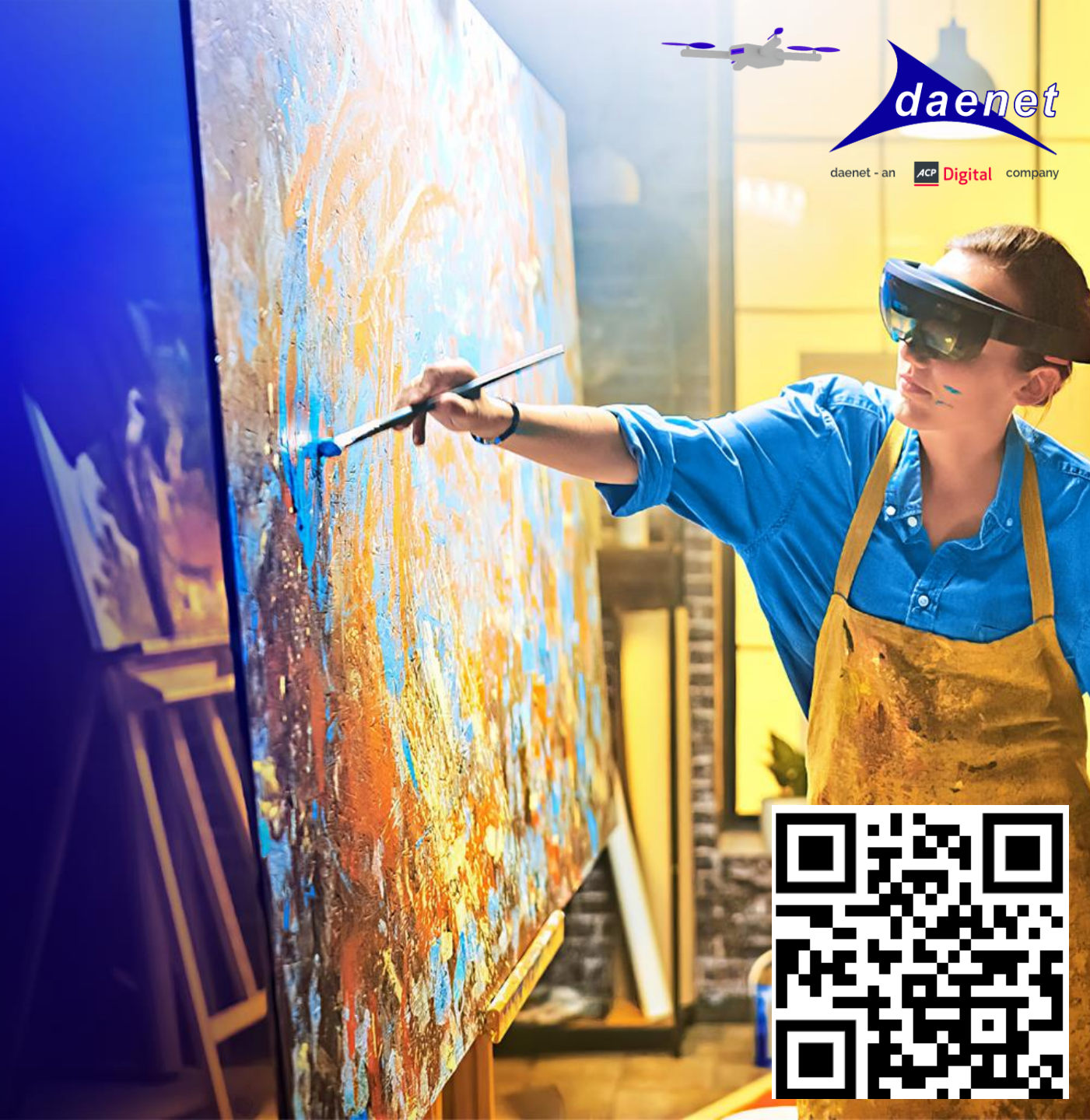
Imagine AI Art Generator

Midjourney

Azure AI SDK - Azure AI Studio

BOOK OF NEWS - Microsoft Ignite

Azure OpenAI und Semantic Kernel für Softwareentwickler



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Dr. Damir Dobric

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Microsoft Regional Director,

Most Valuable Professional: Azure + IoT

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Pause: 10.30-11.00

https://github.com/ddobric/semantic-kernel-training/settings/access