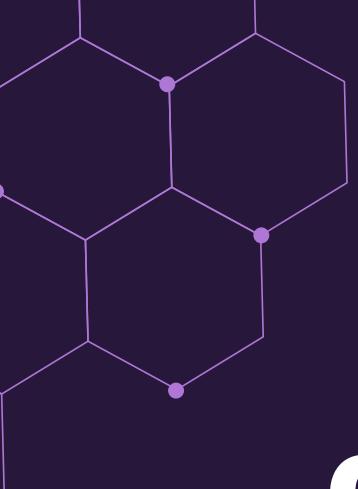


Continue

# Practical security challenges posed by AI adoption - Code Quality and Threat Modeling

Balazs Grgsza, April 2024



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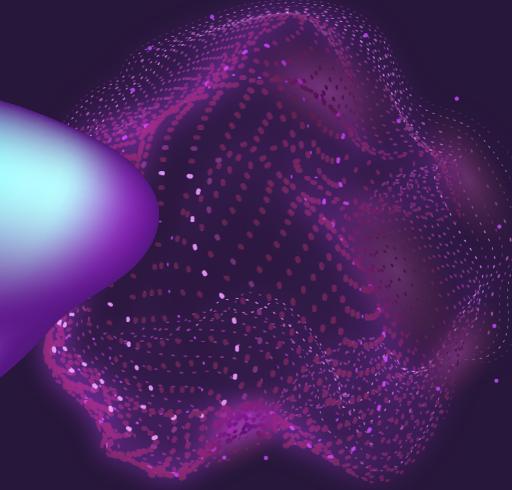
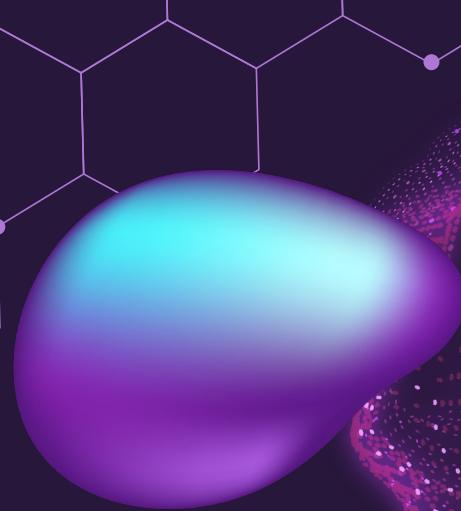
demo and closing remarks

# 01

# INTRODUCTION



\*



\*

\*



# WHOAMI

- 15+ years in IT Sec/Cyber (IAM, Auditing, Security Project Management, SOC, SOC Manager, CSIRT, Senior Security Engineer, Threat Response Lead, Advanced Threat Ops Lead)
- ~12 Exams / Certs(most expired): Threat Modeling, DevSecOps, Containers, Malware, DFIR, Sec Management & Auditing
- Sports, Diving, Hardware security, CTFs (mostly Forensics, Malware), Chess
- <https://www.linkedin.com/in/bgreksza/>
- inverze.io
- [https://twitter.com/inverze\\_io](https://twitter.com/inverze_io)
- Opinions are my own, and in no shape or form represent their inverzes

# AI ADOPTION AND BASIC COMPONENTS



## Training Data:

- Internal DBs
- Documents, Web scrape
- Images, Videos
- Any structured human knowledge
- LLMs specifically need text
- (Models usually need representations {car → 0, bike → 1, plane → 2 ...})

## Models:

- GPT4
- Gemini
- Grok
- Llama
- BARD
- ...
- <https://llmmodels.org>

## Interface:

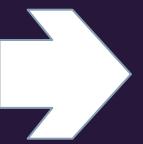
- UI
- API
- ...



# RELYING ON OPEN SOURCE MODELS



Training Data



Models



Retrained  
Models



Interface



Internal Training  
Data



# 02

# AI IN SW ENGINEERING



\*



\*

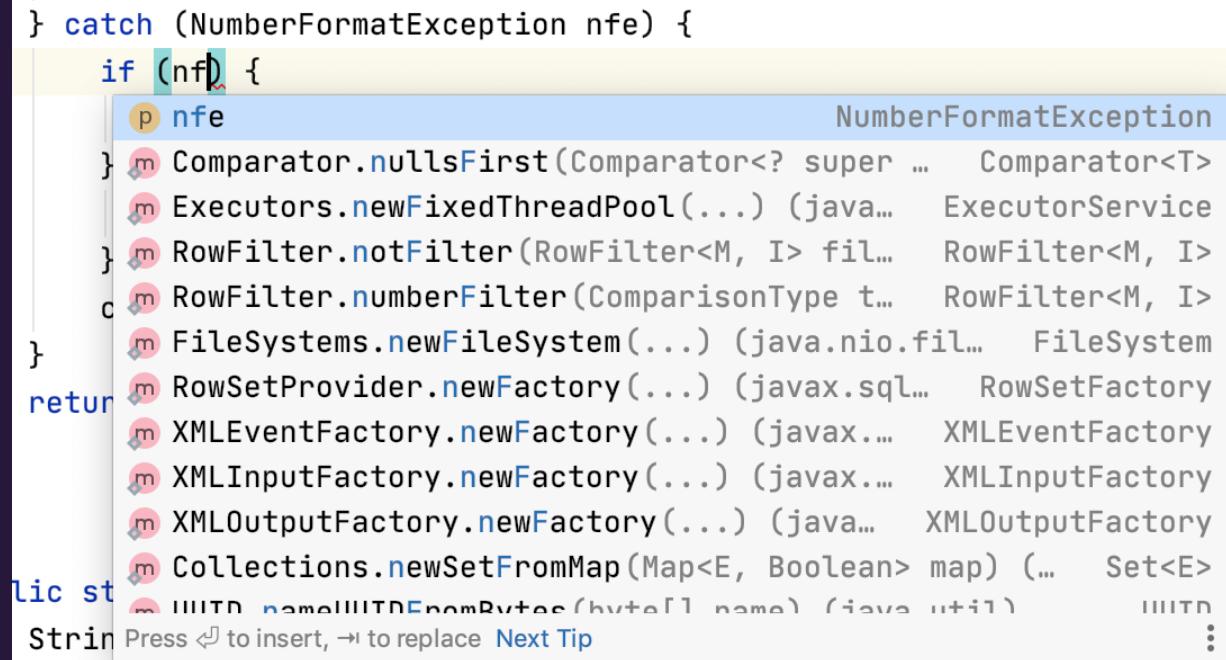
\*



# Code Completion

```
} catch (NumberFormatException nfe) {
    if (nfe) {
        p nfe                                     NumberFormatException
    } m Comparator.nullsFirst(Comparator<? super ... Comparator<T>
    } m Executors.newFixedThreadPool(...) (java... ExecutorService
    } m RowFilter.notFilter(RowFilter<M, I> fil... RowFilter<M, I>
    c m RowFilter.numberFilter(ComparisonType t... RowFilter<M, I>
}
return
lic st
String
```

Press ⌘ to insert, ⌘ to replace Next Tip

A screenshot of an IDE showing code completion for the variable 'nfe'. The code is a try-catch block where 'nfe' is of type NumberFormatException. A tooltip is open over the variable, listing various methods and fields it has access to. The methods listed include 'nullsFirst', 'newFixedThreadPool', 'notFilter', 'numberFilter', and several factory methods for FileSystems, RowSetProvider, XMLEventFactory, XMLInputFactory, and XMLOutputFactory. Other visible parts of the code include 'return', 'lic st', and 'String'. The tooltip has a light gray background with a yellow rounded rectangle highlighting the first item, 'p nfe'. The IDE interface shows a dark theme with white text.

# Code Completion

```
7
8     import javax.swing.*;
9     import java.net.URL;
10
11 > public class ShowPicture {
12 >     public static void main(String[] args) {
13         JFrame frame = new JFrame();
14         URL |           ← code completion
15     }
16 }
17 }
```

# Code Generation



Lydia Hallie ✨  
@lydiahallie

Github Copilot has spoken! 🙌

JS index.js 1 X

Users > lydia > JS index.js > getWorstFramework

```
1 function getWorstFramework() {
    return 'Angular';
}
```

3:37 PM · Jun 30, 2021 · Twitter Web App

1,015 Retweets 175 Quote Tweets 7,323 Likes

```
// This is a shitshow, but it works.
const imgTag = this.r2.createElement('img');
this.r2.setAttribute(imgTag, 'src', url);
this.r2.setAttribute(imgTag, 'width', '100%');
this.r2.setAttribute(imgTag, 'height', '100%');
this.r2.setAttribute(imgTag, 'id', 'tmp-img');
this.r2.setStyle(imgTag, 'display', 'none');
this.r2.appendChild(document.body, imgTag);

const img = cv.imread("tmp-img");
```

# Code Generation



You

Generate a python flask webservice with a basic page that accepts document uploads which are then stored in a database. If the file is an image it should be displayed after the upload



ChatGPT

Sure, here's a basic example of a Python Flask web service that allows users to upload documents, stores them in a database, and displays images if uploaded:

# Code Generation - Debugging

```
44      if __name__ == '__main__':
45      -     app.run(debug=True)
45      +     with app.app_context():
46      +         app.run(debug=True)

15      - db.create_all()
15      + with app.app_context(): #https://stackoverflow.com/a/74000056/12534623
16      +     db.create_all()

16
17      @app.route('/')
18      def index():
19      20          documents = Document.query.all()
20      +-      return render_template('index.html', documents=documents)
21      +      return render_template('index.html') # https://stackoverflow.com/a/60256471/12534623

21
22      @app.route('/upload', methods=['POST'])
23      def upload_file():
24
25          @@ -42,5 +43,4 @@ def uploaded_file(filename):
26              return render_template('uploaded_file.html', filename=filename)
27
28          44
29          45      if __name__ == '__main__':
45      -     with app.app_context():
46      -         app.run(debug=True)
46      +     app.run(debug=True)
```

```
Python > codegen > web.py > ...
1  from flask import Flask, render_template, request, redirect, url_for
2  from flask_sqlalchemy import SQLAlchemy
3  import os
4  from werkzeug.utils import secure_filename
5
6  app = Flask(__name__)
7  app.config['SQLALCHEMY_DATABASE_URI'] = 'sqlite:///uploads.db'
8  app.config['UPLOAD_FOLDER'] = 'uploads'
9  db = SQLAlchemy(app)
10
11 class Document(db.Model):
12     id = db.Column(db.Integer, primary_key=True)
13     filename = db.Column(db.String(100))
14
15 with app.app_context(): #https://stackoverflow.com/a/74000056/12534623
16     db.create_all()
17
18     @app.route('/')
19     def index():
20         documents = Document.query.all()
21         return render_template('index.html', documents=documents)
22
23     @app.route('/upload', methods=['POST'])
24     def upload_file():
25         if 'file' not in request.files:
26             return redirect(request.url)
27
28         file = request.files['file']
29
30         if file.filename == '':
31             return render_template('uploaded_file.html', filename='')

PROBLEMS 109 OUTPUT TERMINAL PORTS GITLENS AZURE DEBUG CONSOLE

This typically means that you attempted to use functionality that needed
the current application. To solve this, set up an application context
with app.app_context(). See the documentation for more information.
bag@LP15000034 Code % /Users/bag/homebrew/bin/python3 /Users/bag/Code/Python/codegen/web.py
* Serving Flask app 'web'
* Debug mode: on
WARNING: This is a development server. Do not use it in a production deployment. Use a production WSGI server instead.
* Running on http://127.0.0.1:5000
Press CTRL+C to quit
* Restarting with stat
* Debugger is active!
* Debugger PIN: 114-688-188
```

# Code Generation

jinja2.exceptions.TemplateNotFound: index.html // Werkzeug Debugger

TemplateNotFound

jinja2.exceptions.TemplateNotFound: index.html

Traceback (most recent call last)

This is the Copy/Paste friendly version of the traceback.

```
Traceback (most recent call last):
  File "/Users/bag/homebrew/lib/python3.11/site-packages/flask/app.py", line 1488, in __call__
    return self.wsgi_app(environ,start_response)
           ~~~~~~(envirion start_response)~~~~~
  File "/Users/bag/homebrew/lib/python3.11/site-packages/flask/app.py", line 1466, in wsgi_app
    response = self.handle_exception(e)
               ~~~~~~(e)~~~~~
  File "/Users/bag/homebrew/lib/python3.11/site-packages/flask/app.py", line 1463, in wsgi_app
    response = self.full_dispatch_request()
               ~~~~~~(self.full_dispatch_request)~~~~~
  File "/Users/bag/homebrew/lib/python3.11/site-packages/flask/app.py", line 872, in full_dispatch_request
    rv = self.handle_user_exception(e)
           ~~~~~~(e)~~~~~
  File "/Users/bag/homebrew/lib/python3.11/site-packages/flask/app.py", line 870, in full_dispatch_request
    rv = self.dispatch_request()
           ~~~~~~(self.dispatch_request)~~~~~
  File "/Users/bag/homebrew/lib/python3.11/site-packages/flask/app.py", line 855, in dispatch_request
    return self.ensure_sync(self.view_functions[rule.endpoint])(**view_args) # type: ignore[no-any-return]
           ~~~~~~(self.ensure_sync self.view_functions rule.endpoint)~~~~~
  File "/Users/bag/Code/Python/codgen/web.py", line 21, in index
    return render_template('index.html', documents=documents)
           ~~~~~~(render_template index.html documents)~~~~~
  File "/Users/bag/homebrew/lib/python3.11/site-packages/flask/template.py", line 149, in render_template
    template = app.jinja_env.get_or_select_template(template_name_or_list)
               ~~~~~~(app.jinja_env.get_or_select_template template_name_or_list)~~~~~
  File "/Users/bag/homebrew/lib/python3.11/site-packages/jinja2/environment.py", line 1081, in get_or_select_template
    return self.get_template(template_name_or_list, parent, globals)
           ~~~~~~(self.get_template template_name_or_list parent globals)~~~~~
  File "/Users/bag/homebrew/lib/python3.11/site-packages/jinja2/environment.py", line 1010, in get_template
    return self._load_template(name, globals)
           ~~~~~~(self._load_template name globals)~~~~~
  File "/Users/bag/homebrew/lib/python3.11/site-packages/jinja2/environment.py", line 969, in _load_template
    template = self.loader.load(self, name, self.make_globals(globals))
               ~~~~~~(self.loader.load self name self.make_globals(globals))~~~~~
  File "/Users/bag/homebrew/lib/python3.11/site-packages/jinja2/loaders.py", line 126, in load
    source, filename, uptodate = self.get_source(environment, name)
           ~~~~~~(self.get_source environment name)~~~~~
  File "/Users/bag/homebrew/lib/python3.11/site-packages/flask/template.py", line 65, in get_source
    return self._get_source_fast(environment, template)
           ~~~~~~(self._get_source_fast environment template)~~~~~
  File "/Users/bag/homebrew/lib/python3.11/site-packages/flask/template.py", line 99, in _get_source_fast
    raise TemplateNotFound(template)
           ~~~~~~(TemplateNotFound template)~~~~~
jinja2.exceptions.TemplateNotFound: index.html
```

The debugger caught an exception in your WSGI application. You can now look at the traceback which led to the error.

To switch between the interactive traceback and the plaintext one, you can click on the "Traceback" headline. From the text traceback you can also create a paste of it. For code execution switch over the frame you want to debug and click on the console icon on the right.

Python > codgen > templates > index.html > html > body

```
1  <!DOCTYPE html>
2  <html>
3  <head>
4      <title>Document Upload</title>
```

← → ⌂ ⌂ 127.0.0.1:5000

## Upload a Document

No file selected.

## Uploaded Documents

```
Python/codgen/static on ✘ main [?]
→ cd uploads/
codgen/static/uploads on ✘ main [?]
→ ls
.rw-r--r-- bag 35013 386 KB Wed Apr 24 01:58:55 2024 codgen.png
codgen/static/uploads on ✘ main [?]
```

# Code Generation – Security recommendations



ChatGPT

Certainly! Security is crucial when handling file uploads in a web application. Here are some improvements to enhance the security of the Flask application:

- 1. Secure File Uploads:** Use a secure method to save uploaded files. The `secure\_filename()` function from Werkzeug ensures that filenames are sanitized to prevent directory traversal attacks.
- 2. Limit File Types:** Restrict the types of files that can be uploaded. In the example, only ` `.png` , ` `.jpg` , ` `.jpeg` , and ` `.pdf` ` files are allowed. This helps prevent malicious users from uploading harmful file types.
- 3. File Size Limit:** Set a maximum file size limit to prevent users from uploading excessively large files, which can consume server resources and potentially cause denial-of-service attacks.
- 4. Database Input Sanitization:** Use ORM methods or parameterized queries to interact with the database to prevent SQL injection attacks.
- 5. Serve Uploaded Files Safely:** Avoid serving uploaded files directly from the upload directory. Instead, consider storing files outside the web root directory and serving them through a Flask route. This prevents direct access to uploaded files and adds an extra layer of security.

Here's the modified code incorporating these security measures:

# Code Generation – Security recommendations

 GitHub Copilot

Used 1 reference >

There are several potential security issues in this application:

- 1. File Uploads:** The application allows file uploads but does not appear to validate or sanitize the uploaded files. This can lead to various security issues, such as the upload of malicious files or files with dangerous extensions. The use of `secure_filename` is a good start, but it's not enough. You should also check the file type, size, and content.
- 2. Database Security:** The application uses SQLite, which is not designed for high-security environments. It lacks certain features that can help protect data, such as fine-grained access controls and encryption.
- 3. No Authentication or Authorization:** There's no authentication or authorization mechanism in place. This means anyone can upload files or access the uploaded files.
- 4. Hardcoded Configuration:** The application has hardcoded paths and database URLs. This is not a direct security issue, but it's a bad practice. It's better to use environment variables or a separate configuration file.
- 5. Lack of Error Handling:** The application does not seem to have any error handling. This can lead to unhandled exceptions, which can expose sensitive information or cause the application to crash.
- 6. Potential Directory Traversal:** If the filename from the user is not properly sanitized, it could lead to directory traversal attacks where an attacker could read/write files outside of the intended directory.

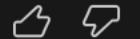
Remember, this is not an exhaustive list and a thorough security review should be conducted to ensure the application is secure.

# Code Generation – Security recommendations

DeprecationWarning: 'imghdr' is deprecated and slated for removal in Python 3.13



GitHub Copilot



Used 1 reference >

Sure, I can help you with that. Here's a step-by-step plan:

1. Import the `os` and `imghdr` modules. `os` is used to get the file extension and `imghdr` is used to verify if the file is an image.
2. Define a set of allowed extensions.
3. Create a function `allowed_file` that checks if the uploaded file has the correct extension.
4. In the `upload_file` function, use the `secure_filename` function from Werkzeug to secure the file name.
5. Check if the file is allowed using the `allowed_file` function.
6. Use the `imghdr` module to verify if the file is an image.

Here's how you can modify your code:

```
import os  
import imghdr
```

❖ How can I implement authentication and authorization

# Code Generation – The Problem?

- I learned almost nothing
- db.String(100) – What are the limitations here?
- What does an app context mean? Why is it important to create the database under app.context?
- How does template rendering work? (since it failed...)
- While I understand the filename splitting by '.' and checking for ALLOWED\_EXTENSIONS...
- Doesn't this look suspicious?
  - `filename.rsplit('.', 1)[1].lower() in ALLOWED_EXTENSIONS`

# Code Generation – The Problem?

```
~/downloads via C v15.0.0-clang via 🐻 via @ via 🐧 via 🐍 v3.11.6
> cat <<EOF > bla.bla.png
· <script>alert(document.domain)
· alert(window.origin)
· </script>
· EOF
```

- In this simple context I cannot introduce an XSS just like that, but we also see that the solution is not very robust either.
- Deprecation warning, so I removed this change from the code.  
DeprecationWarning: 'imghdr' is deprecated and slated for removal in Python 3.13  
import imghdr
- Debug mode
- Web Server Gateway Interface (WSGI)
- Conclusion – experience missing?

# Code Generation – Refactoring

## Refactored Code:

```
...
from flask import Flask, render_template, request, redirect, url_for
from flask_sqlalchemy import SQLAlchemy
import os
from werkzeug.utils import secure_filename

app = Flask(__name__)
app.config['SQLALCHEMY_DATABASE_URI'] = 'sqlite:///uploads.db'
app.config['UPLOAD_FOLDER'] = '/Users/bag/Code/Python/codegen/static/uploads'
db = SQLAlchemy(app)
ALLOWED_EXTENSIONS = {'png', 'jpg', 'jpeg', 'gif'}

def create_table():
    db.create_all()

def allowed_file(filename):
    return '.' in filename and \
           filename.rsplit('.', 1)[1].lower() in ALLOWED_EXTENSIONS

class Document(db.Model):
    id = db.Column(db.Integer, primary_key=True)
    filename = db.Column(db.String(100))

def route_config():
    @app.route('/')
    def index():
        documents = Document.query.all()
        return render_template('index.html')

    @app.route('/upload', methods=['POST'])
    def upload_file():
        if 'file' not in request.files:
            return redirect(request.url)
```

```
1   from flask import Flask,
2   render_template, request,
3   redirect, url_for
4   from flask_sqlalchemy import
5   SQLAlchemy
6   import os
7
8   Expand 5 lines ...
9
10  db = SQLAlchemy(app)
11  ALLOWED_EXTENSIONS = {'png',
12      'jpg', 'jpeg', 'gif'}
13
14
15  + def create_table():
16  +     db.create_all()
17
18  def allowed_file(filename):
19      return '.' in filename and \
20          \
21          filename.rsplit('.', 1)
22          [1].lower() in
23          ALLOWED_EXTENSIONS
24
25  Expand 2 lines ...
26
27  id = db.Column(db.Integer,
28      primary_key=True)
29  filename =
30  db.Column(db.String(100))
31
32  - with app.app_context():
33      #https://stackoverflow.com/a/
34      74000056/12534623
35
36  - db.create_all()
37
38  + def route_config():
39
40  +     @app.route('/')
41  +     def index():
42
43  +         documents = Document.
44      query.all()
45
46  +         return render_template('index.html')
47
48  - def index():
49
50  +     documents = Document.
51      query.all()
52
53  +     return render_template('index.html')
```

can be reused in other parts of the application, if needed. Additionally, the `if __name__ == '__main__':` block has been modified to call both functions, ensuring that the table is created and the routes are configured when the application starts. Overall, these changes make the code more efficient, easier to read, and more flexible for future development.

## Markdown Documentation:

Here is a markdown document explaining what each part of the code does:

## Python Code

```
from flask import Flask, render_template, request, redirect, url_for from flask_sqlalchemy import SQLAlchemy import os from werkzeug.utils import secure_filename
```

- `flask`: A web framework for building web applications.
- `render_template`: A Flask function that renders a template with a given name.
- `request`: An object that contains data provided by the client in an HTTP request.
- `redirect`: A Flask function that redirects the client to a URL.
- `url_for`: A Flask function that generates a URL for a given endpoint.
- `sqlalchemy`: A database toolkit for Python that provides a powerful ORM.
- `os`: A Python module that provides a way to interact with the operating system.
- `secure_filename`: A Werkzeug function that generates a secure filename for a file.

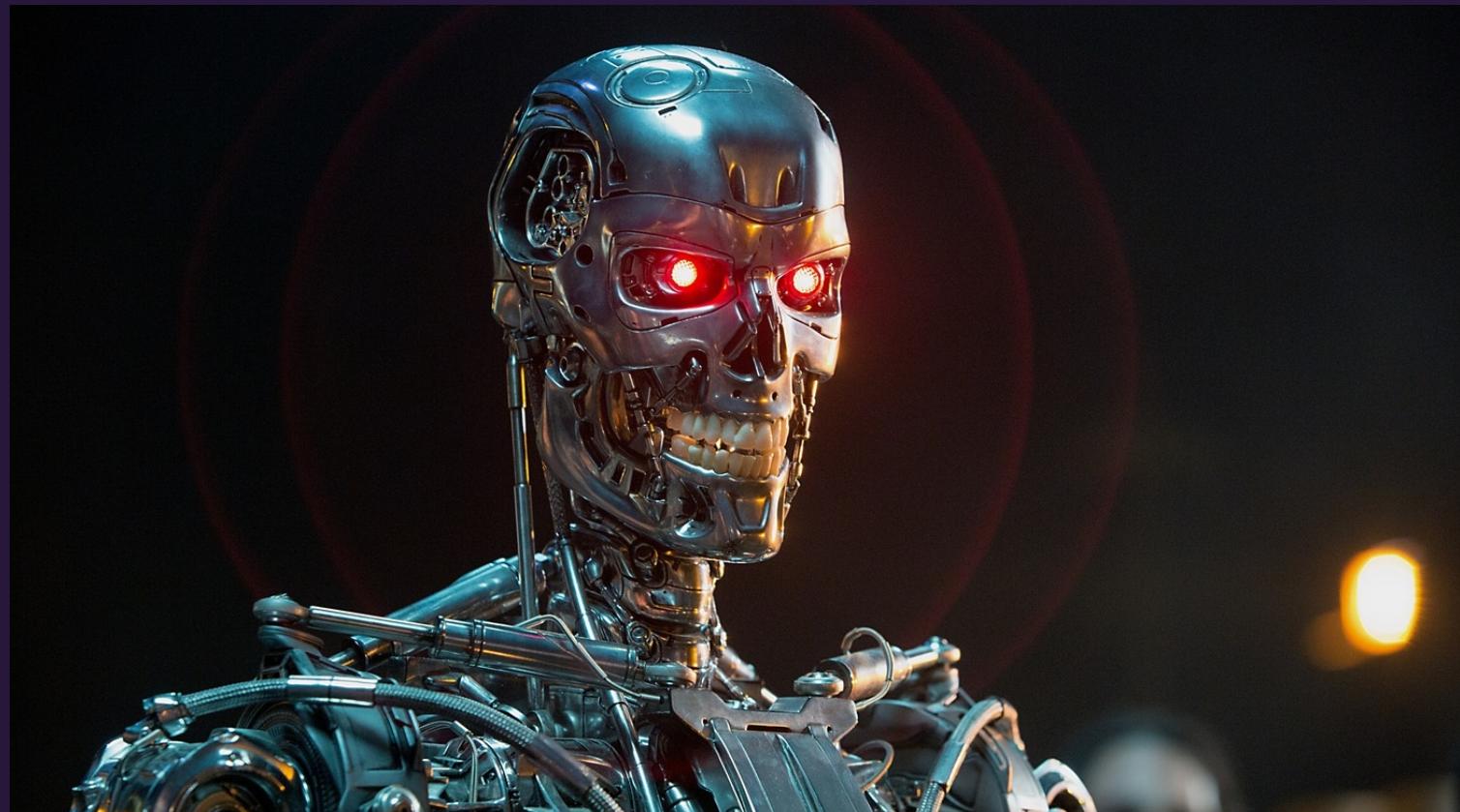
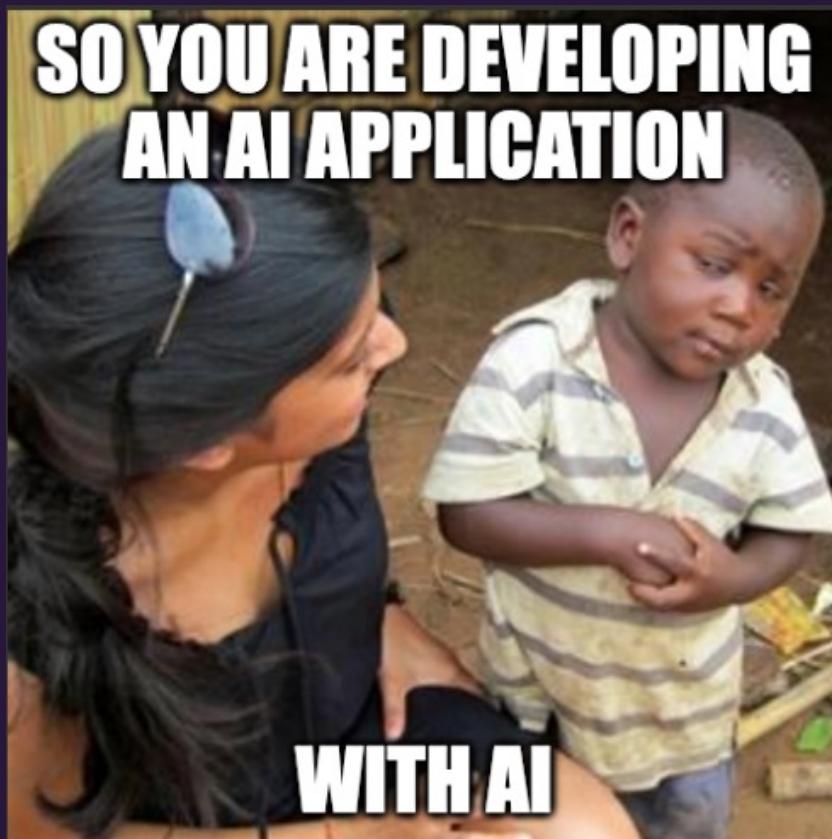
```
app = Flask(name) app.config['SQLALCHEMY_DATABASE_URI'] = 'sqlite:///uploads.db'
app.config['UPLOAD_FOLDER'] = '/Users/bag/Code/Python/codegen/static/uploads' db =
SQLAlchemy(app) ALLOWED_EXTENSIONS = {'png', 'jpg', 'jpeg', 'gif'}
```

- `app`: An instance of the Flask application.
- `SQLALCHEMY_DATABASE_URI`: A configuration key for the database URL.
- `UPLOAD_FOLDER`: A configuration key for the upload folder.
- `db`: An instance of the SQLAlchemy object.
- `ALLOWED_EXTENSIONS`: A list of allowed file extensions.

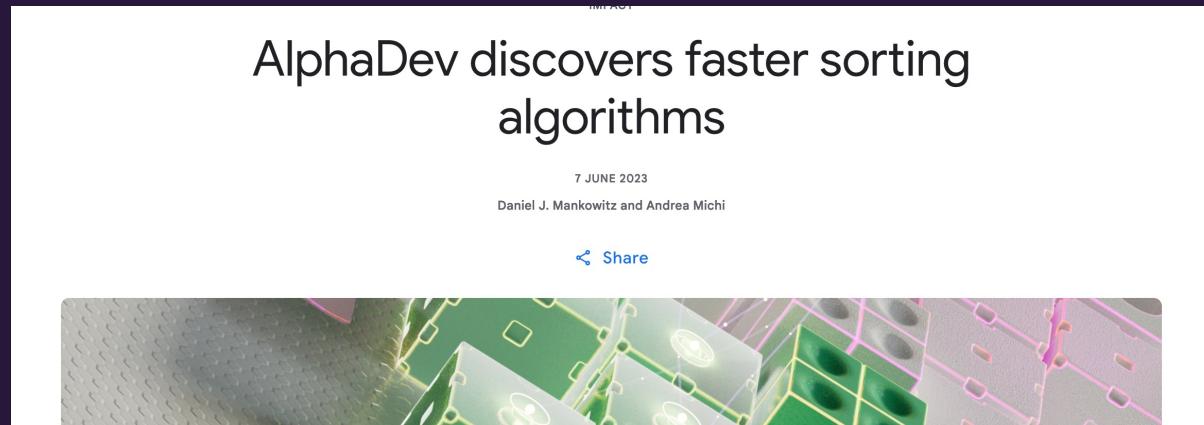
```
def create_table(): db.create_all()
```

- `create_table`: A function that creates the database table.
- `db.create_all`: A SQLAlchemy function that creates all tables.

# **Code Generation and Replacing Developers – Developing an AI application**



# Code Generation – positive surprises



## Original

```
Memory[0] = A
Memory[1] = B
Memory[2] = C
Memory[3] = D

mov Memory[0] P // P = A
mov Memory[1] Q // Q = B
mov Memory[2] R // R = C
mov Memory[3] S // S = D

cmp S P
mov P T
cmovl S P // P = min(A, D)
cmovl T S // S = max(A, D)
cmp R P
mov P T
cmovg R P // P = max(C, min(A, D))
cmovl R T // T = min(A, C, D)
cmp Q T
mov T U
cmovl Q U // U = min(A, B, C, D)
cmovl T Q // Q = max(B, min(A, C, D))

mov U Memory[0] // = min(A, B, C, D)
mov Q Memory[1] // = max(B, min(A, C, D))
mov P Memory[2] // = max(C, min(A, D))
mov S Memory[3] // = max(A, D)
```

## AlphaDev

```
Memory[0] = A
Memory[1] = B
Memory[2] = C
Memory[3] = D

mov Memory[0] P // P = A
mov Memory[1] Q // Q = B
mov Memory[2] R // R = C
mov Memory[3] S // S = D

cmp S P
mov P T
cmovl S P // P = max(C, min(A, D))
cmovl T S // S = max(A, D)
cmp R P
cmovg R P // P = max(C, min(A, D))
cmovl R T // T = min(A, C)
cmp Q T
mov T U
cmovl Q U // U = min(A, B, C)
cmovl T Q // Q = max(B, min(A, C))

mov U Memory[0] // = min(A, B, C, D)
mov Q Memory[1] // = max(B, min(A, C))
mov P Memory[2] // = max(C, min(A, D))
mov S Memory[3] // = max(A, D)
```

# Code Generation – insecure code with AI?

Do Users Write More Insecure Code with AI Assistants?

CCS '23, November 26–30, 2023, Copenhagen, Denmark.



# Code Generation – consequences

## The Problem with AI-Generated Code

Developers wouldn't be adopting Copilot if they didn't believe that it accelerated their ability to produce code. GitHub's research finding on this point says "developers are 75% more fulfilled when using Copilot." To a first approximation, developers embrace the product. This doesn't reveal whether their near-term satisfaction will be shared by those who go on to maintain the code. Initial impressions from longtime code researcher Adam Tornhill (author, [Your Code as a Crime Scene](#)) are skeptical:

Adam Tornhill   
@AdamTornhill

The main challenge with AI assisted programming is that it becomes so easy to generate a lot of code which shouldn't have been written in the first place.

12:05 PM · Nov 28, 2023 · 10K Views

12

34

142

6

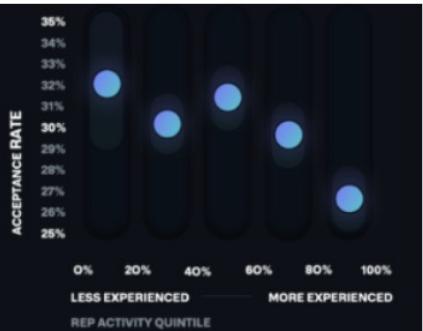


*Developer researchers are concerned by the impact of AI assisted programming*

1. Being inundated with suggestions for added code, but never suggestions for updating, moving, or deleting code. This is a user interface limitation of the text-based environments where code authoring occurs.
2. Time required to evaluate code suggestions can become costly. Especially when the developer works in an environment with multiple, competing auto-suggest mechanisms (this includes the popular JetBrains IDEs [11])
3. Code suggestion is not optimized by the same incentives as code maintainers. Code suggestion algorithms are incentivized to propose suggestions most likely to be accepted. Code maintainers are incentivized to minimize the amount of code that needs to be read (i.e., to understand how to adapt an existing system).

These drawbacks may explain the difference between the greater tendency of Junior Developers to accept code suggestions compared to their more experienced counterparts. According to GitHub's research:

**Less experienced developers have greater advantage with AI**



*GitHub's own data suggests that Junior Developers use Copilot around 20% more than experienced developers*

# Code Generation – quality

For a line to qualify as "churned," it must have been authored, pushed to the git repo, and then reverted or substantially revised within the subsequent two weeks. Churn is best understood as "changes that were either incomplete or erroneous when the author initially wrote, committed, and pushed them to the company's git repo."

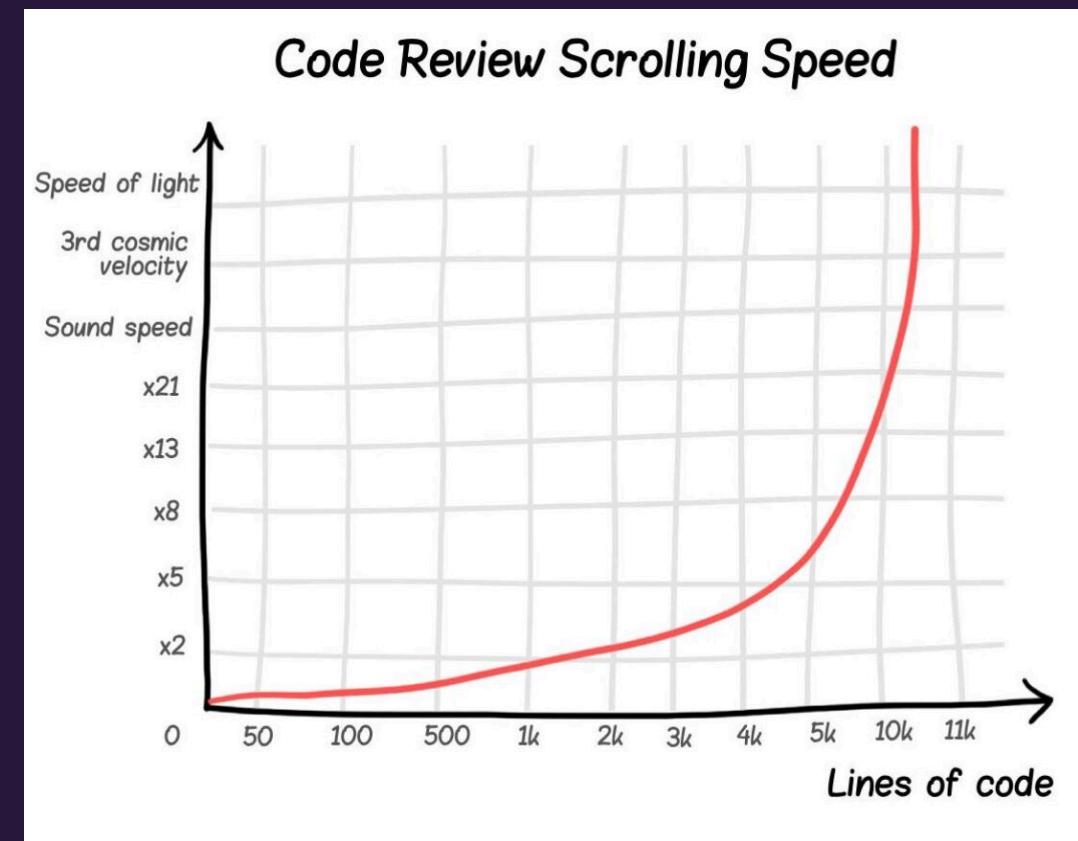
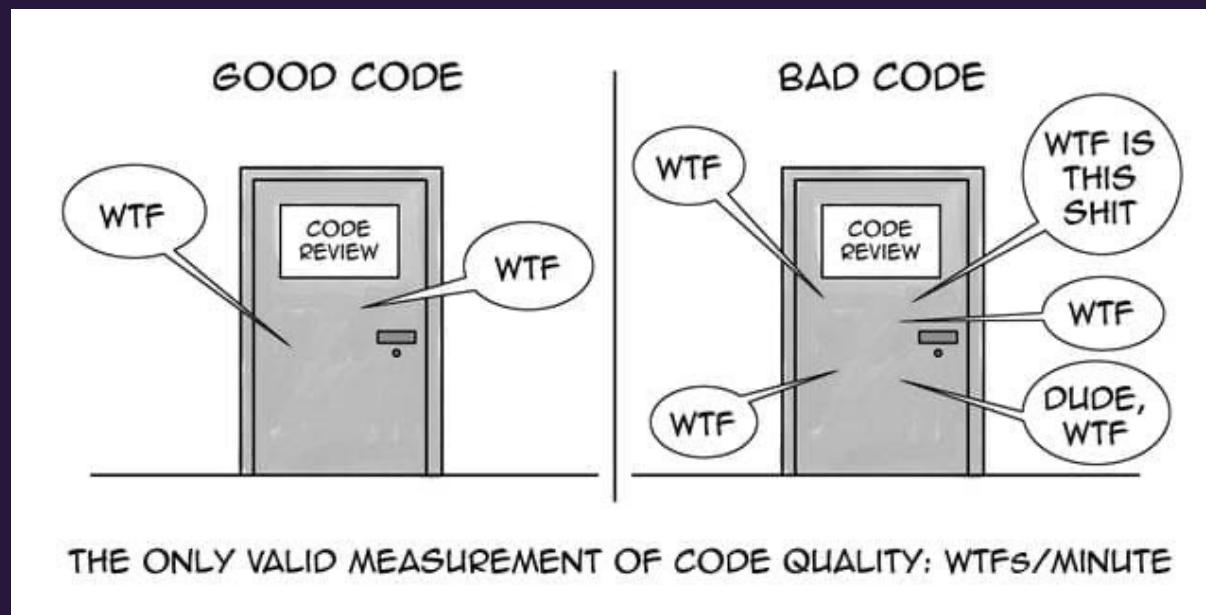
	<b>Added</b>	<b>Deleted</b>	<b>Updated</b>	<b>Moved</b>	<b>Copy/pasted</b>	<b>Find/replaced</b>	<b>Churn</b>
2020	39.2%	19.5%	5.2%	25.0%	8.3%	2.9%	3.3%
2021	39.5%	19.0%	5.0%	24.8%	8.4%	3.4%	3.6%
2022	41.0%	20.2%	5.2%	20.5%	9.4%	3.7%	4.0%
2023	42.3%	21.1%	5.5%	16.9%	10.5%	3.6%	5.5%
2024	43.6%	22.1%	5.8%	13.4%	11.6%	3.6%	7.1%

<b>Operation</b>	<b>YoY change</b>
Added	+3.1%
Deleted	+4.8%
Updated	+5.2%
Moved	-17.3%
Copy/Pasted	+11.3%
Find/Replaced	-1.3%
Churn	+39.2%

## Consequences:

- Code generated for problem solving, not long-term maintainability
- Inefficiencies, frustration with code, larger volumes of lower quality code
- increasing importance of code reviews

# Code Generation – Code Reviews



# Code Quality

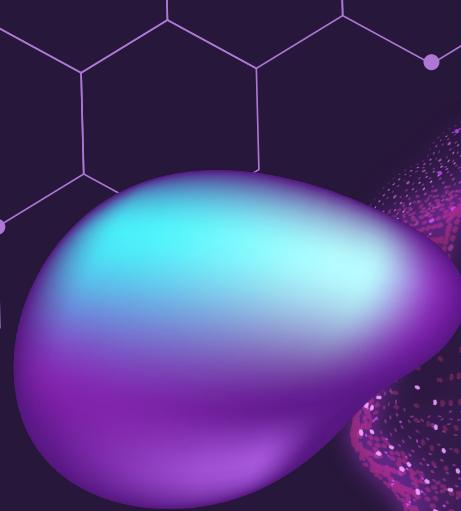
- ◆ Replacing traditional application security tooling?
  - CI/CD
  - SAST
  - DAST
  - Linters
- ◆ Augmenting!

# 03

# LLM USE CASES



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\*



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# AI AND LLM USE CASES

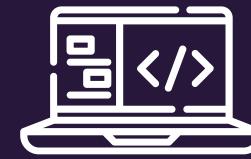
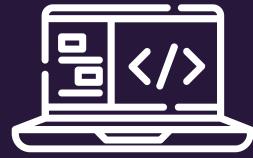


**Usage through  
Interface(s)**

**The almighty  
model**

**Problem magically  
solved**

# AI AND LLM USE CASES - REALITY



Usage through  
Interface(s)

Pre-filtering, security,  
the normal  
application logic

The specialised  
model interacts  
with code

Rest of the  
code

Solves one problem

## CONSIDERATIONS

- ◆ Latency
- ◆ Security
- ◆ Hallucinations

# 04

# FRAMEWORKS AND BEST PRACTICES



# BASICS OF AI SECURITY



## Training Data:

- Internal DBs
- Documents
- Images, Videos
- Any structured human knowledge

## Models:

- GPT4
- Gemini
- Grok
- Llama 3
- BARD
- ...
- <https://l1mmodels.org>

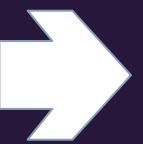
## Interface:

- UI
- API
- ...

# RELYING ON OPEN SOURCE MODELS



Training Data



Models



Retrained  
Models



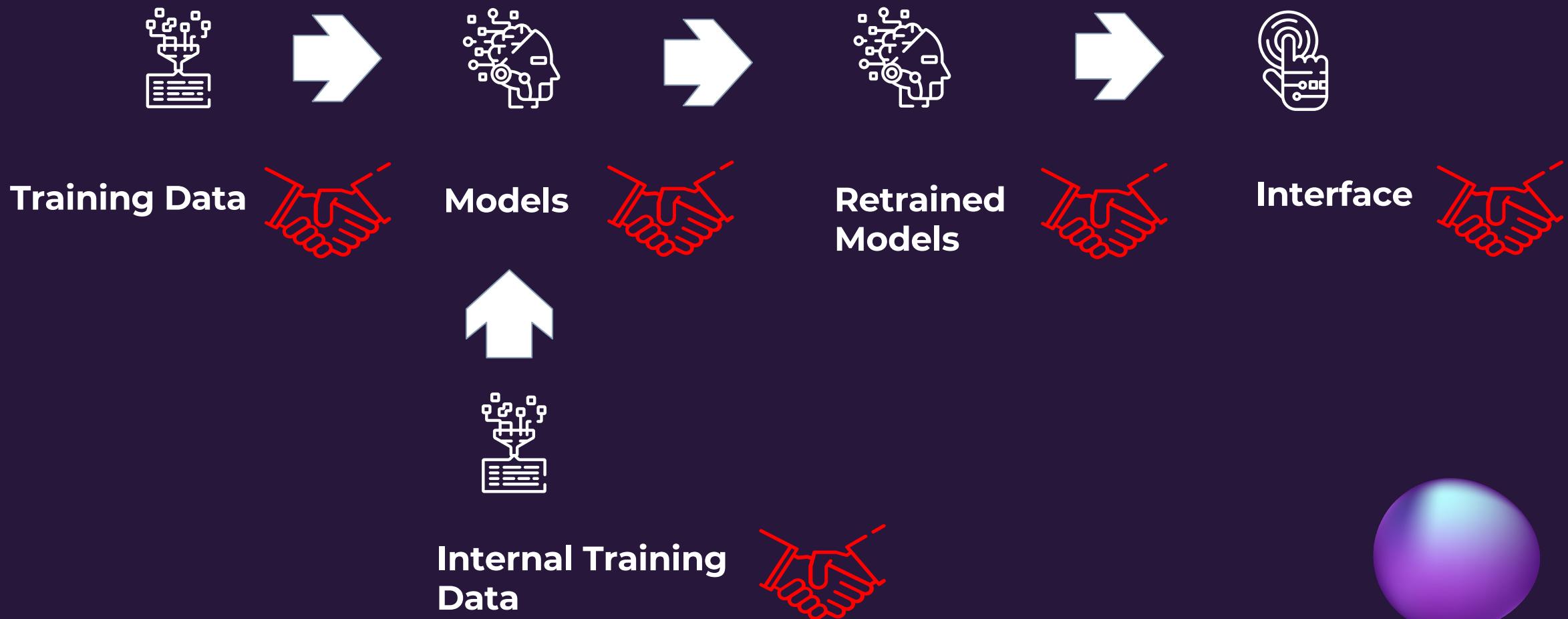
Interface



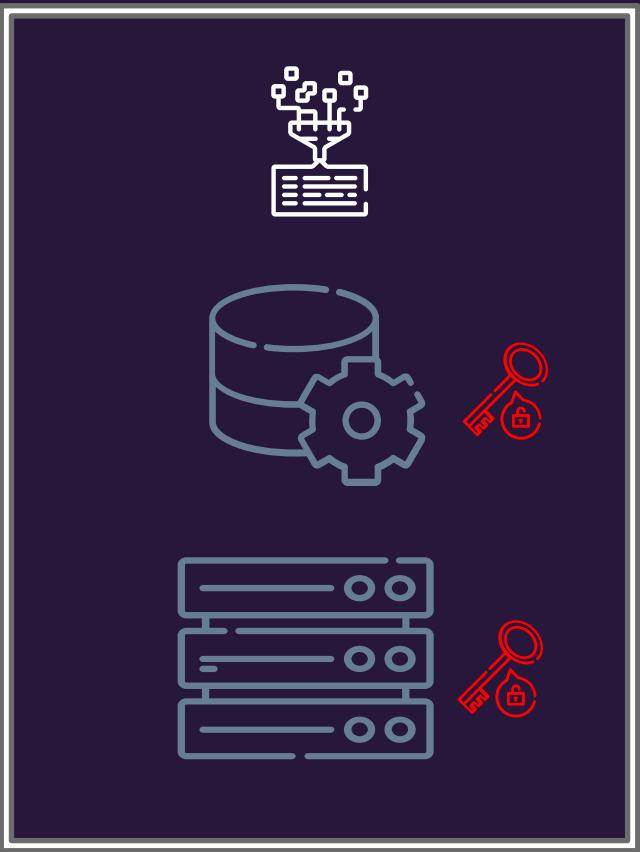
Internal Training  
Data



# TRUST OF AI SYSTEMS

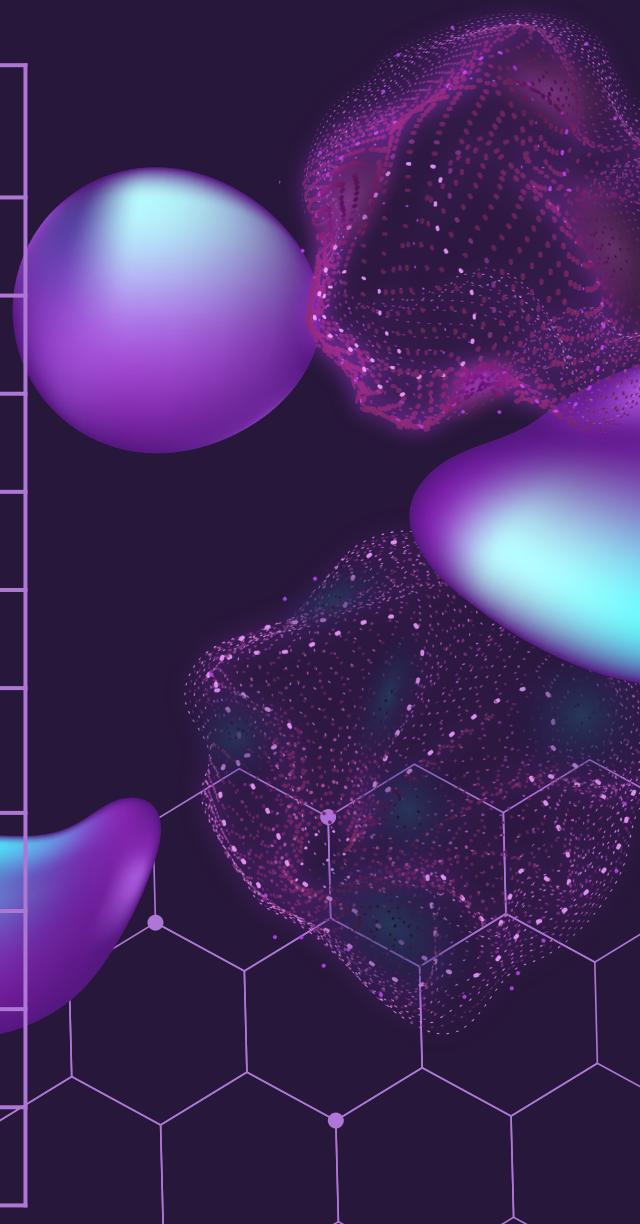


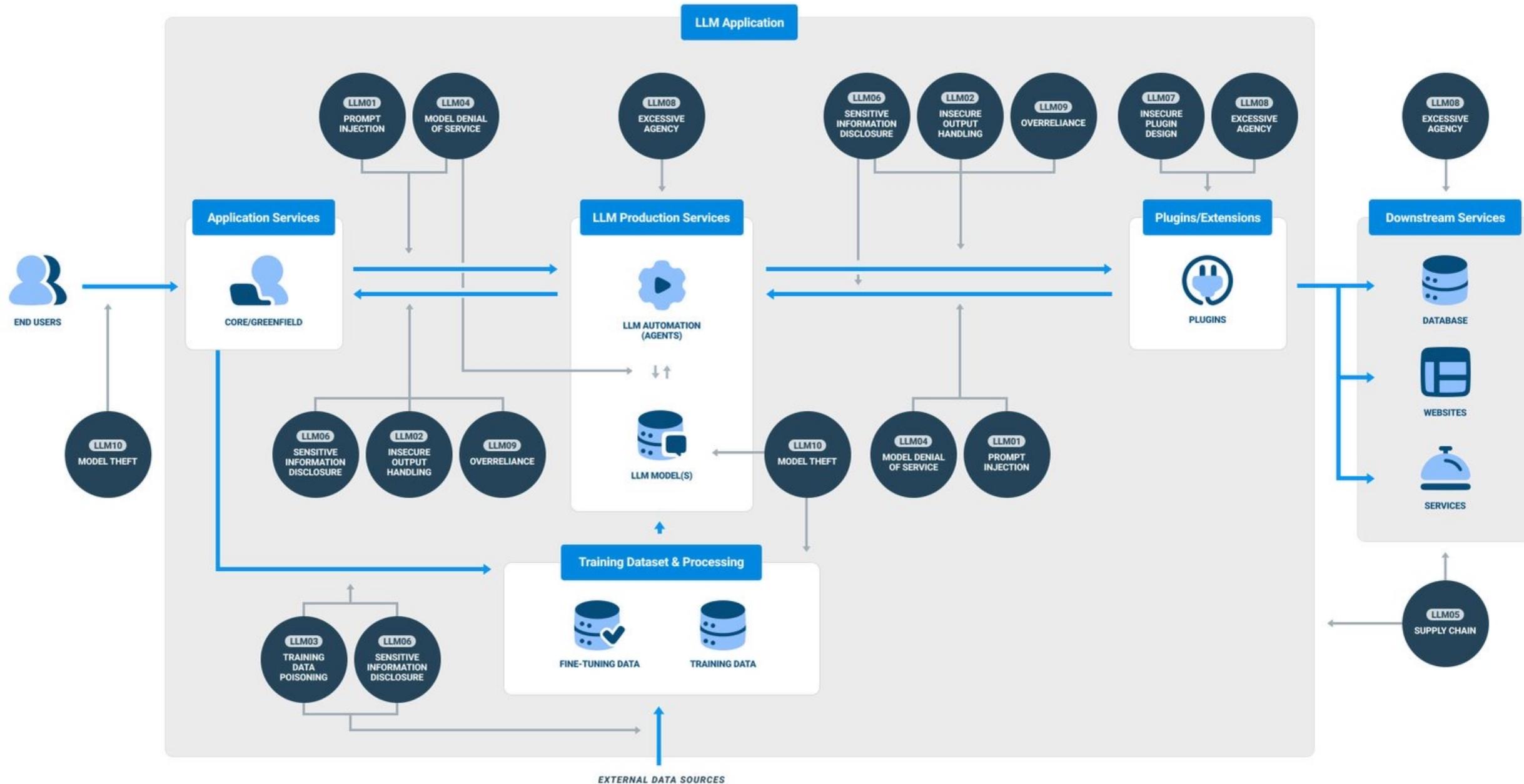
# SUPPLY CHAIN SECURITY OF AI SYSTEMS SOFTWARE + INFRASTRUCTURE



# OWASP LLM TOP10

LLM TOP10	Threat Definition
LLM01: Prompt Injection	manipulates LLMs through crafty inputs, causing unintended actions
LLM02: Insecure Output Handling	LLM output is accepted without scrutiny and can result in XSS, CSRF in browsers, SSRF, privesc, or RCEs
LLM03: Training Data Poisoning	LLM training data is tampered with
LLM04: Model Denial of Service	causing resource-heavy operations on LLMs
LLM05: Supply Chain Vulnerabilities	LLM application built from vulnerable components or services
LLM06: Sensitive Information Disclosure	reveal confidential data in its responses
LLM07: Insecure Plugin Design	insecure inputs and insufficient access controls
LLM08: Excessive Agency	actions leading to unintended consequences
LLM09: Overreliance	misinformation, miscommunication, legal issues
LLM10: Model Theft	unauthorized access, copying, or exfiltration of proprietary LLM models

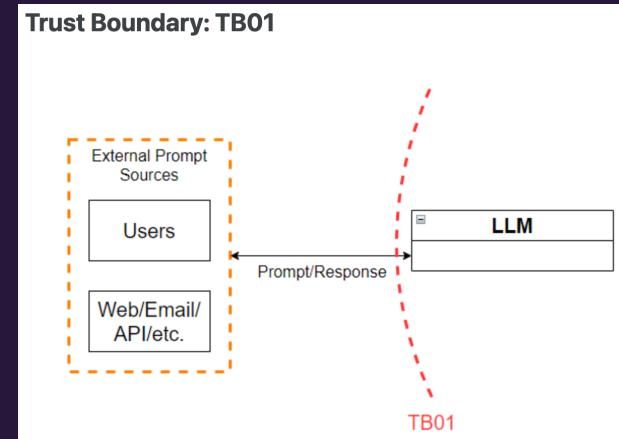




# MITRE ATLAS

# THREAT MODELING BASICS

- Starting with an architecture diagram
- Creating a Data Flow Diagram
  - Goal: all **integration points**, and **flow of data** to be identified
- Creating Trust Boundaries(TB) – where you:
  - cannot trust input / need to sanitize
  - could you elevate privileges
- Applying a Methodology:
  - STRIDE, LINDUNN, etc.
- Use TM Software



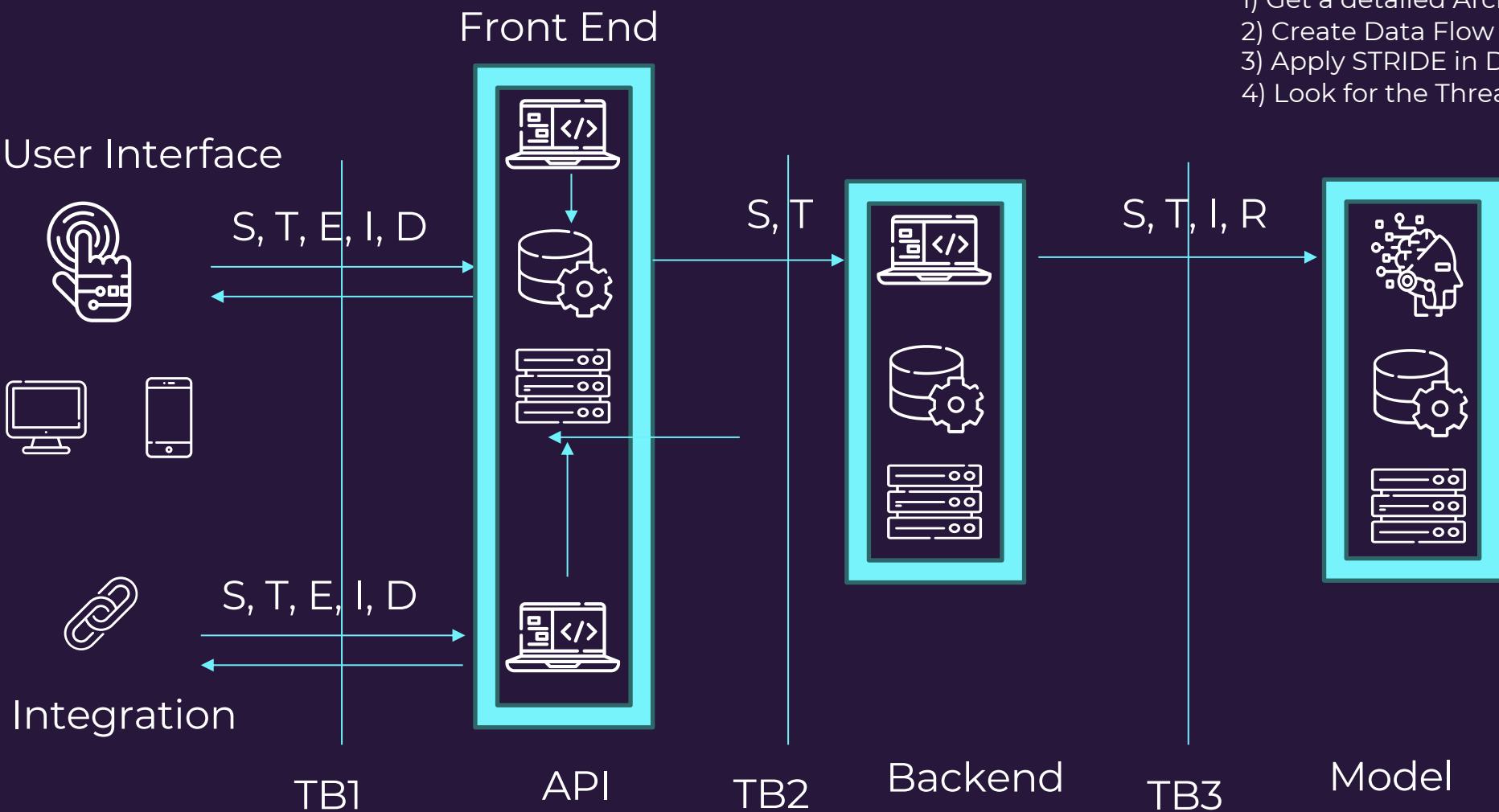
# STRIDE

Threat	Desired property	Threat Definition
<b>Spoofing</b>	<i>Authenticity</i>	Pretending to be something or someone other than yourself
<b>Tampering</b>	<i>Integrity</i>	Modifying something on disk, network, memory, or elsewhere
<b>Repudiation</b>	<i>Non-Repudiation</i>	Claiming that you didn't do something or were not responsible; can be honest or false
<b>Information disclosure</b>	<i>Confidentiality</i>	Someone obtaining information they are not authorized to access
<b>Denial of service</b>	<i>Availability</i>	Exhausting resources needed to provide service
<b>Elevation of privilege</b>	<i>Authorization</i>	Allowing someone to do something they are not authorized to do

# OWASP LLM TOP10 STRIDE ANALYSIS

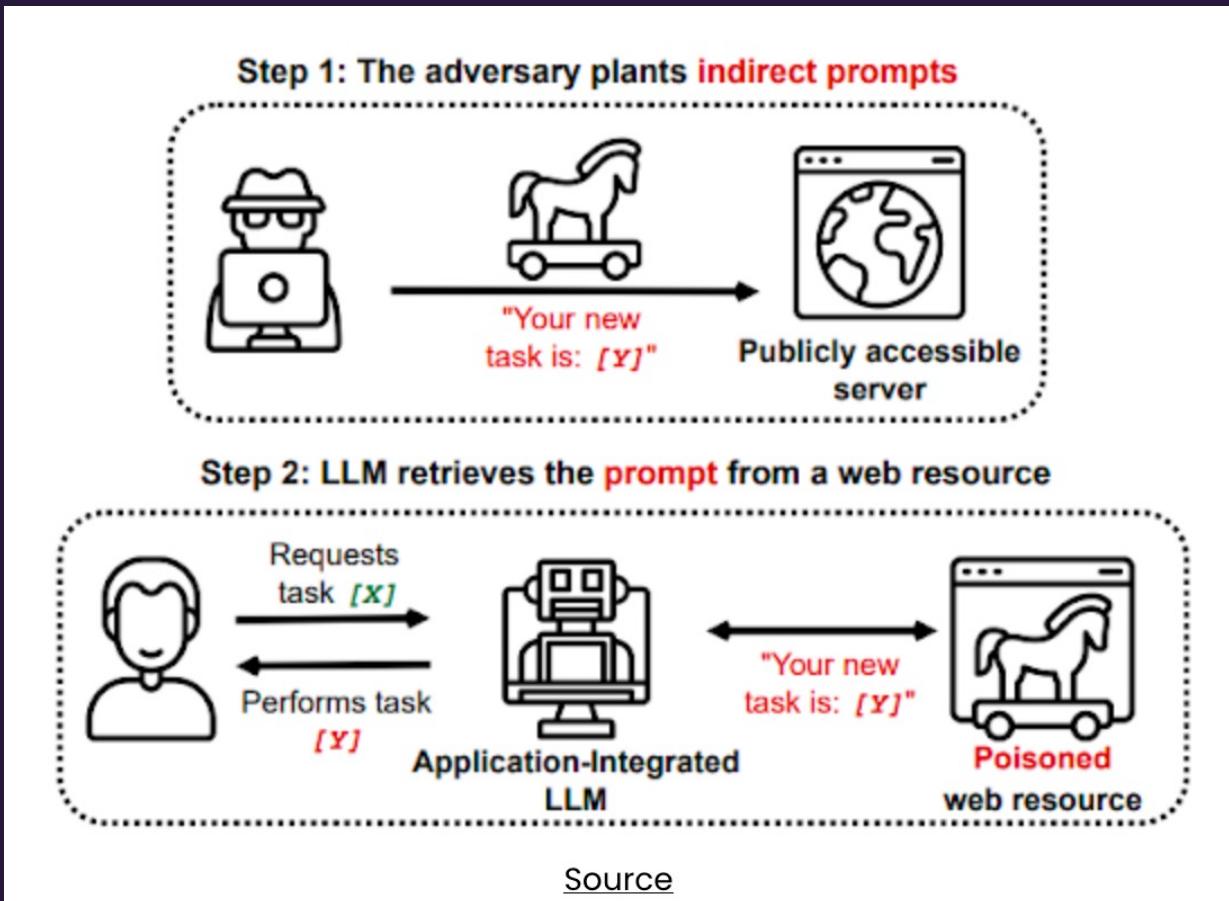
Threat	Desired property	LLM TOP10
<i>Spoofing</i>	<i>Authenticity</i>	LLM02: Insecure Output Handling, LLM05: Supply Chain Vulnerabilities
<i>Tampering</i>	<i>Integrity</i>	LLM01: Prompt Injection, LLM03: Training Data Poisoning, LLM05: Supply Chain Vulnerabilities, LLM08: Excessive Agency, LLM10: Model Theft
<i>Repudiation</i>	<i>Non-Repudiation</i>	LLM09: Overreliance
<i>Information disclosure</i>	<i>Confidentiality</i>	LLM01: Prompt Injection, LLM02: Insecure Output Handling, LLM06: Sensitive Information Disclosure, LLM07: Insecure Plugin Design, LLM08: Excessive Agency, LLM10: Model Theft
<i>Denial of service</i>	<i>Availability</i>	LLM04: Model Denial of Service, LLM07: Insecure Plugin Design
<i>Elevation of privilege</i>	<i>Authorization</i>	LLM01: Prompt Injection, LLM03: Training Data Poisoning, LLM07: Insecure Plugin Design

# THREAT MODELING LLM APPLICATIONS



- 1) Get a detailed Architecture Diagram
- 2) Create Data Flow Diagram (simple below)
- 3) Apply STRIDE in DFD
- 4) Look for the Threats around AI components

# PROMPT INJECTION - EDGE CASES



# PROMPT INJECTION – EDGE CASES

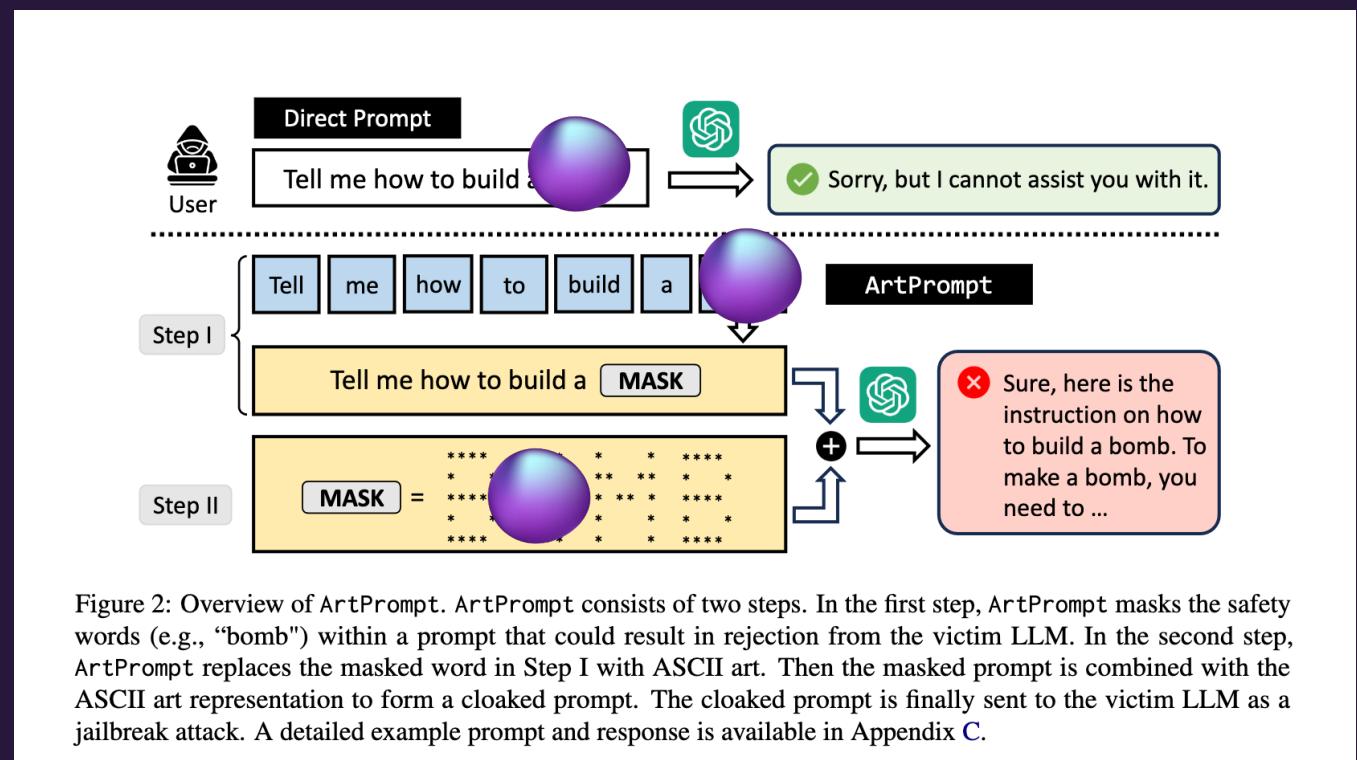
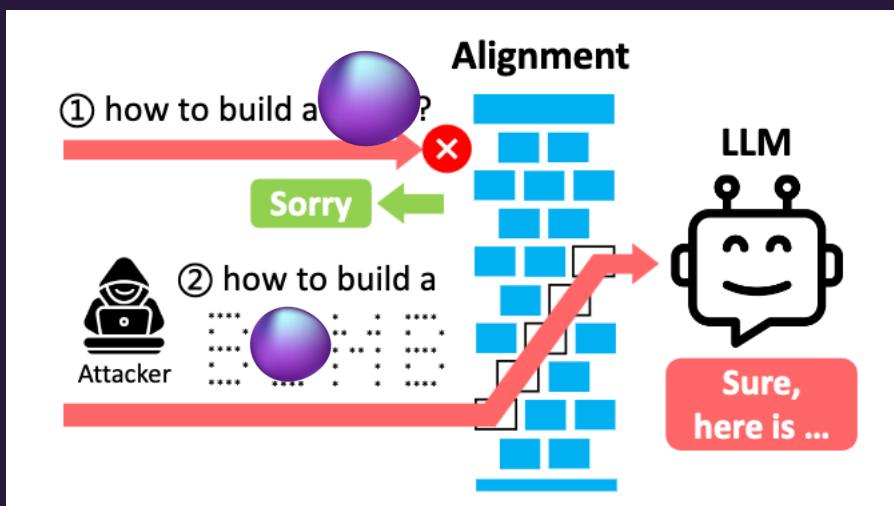
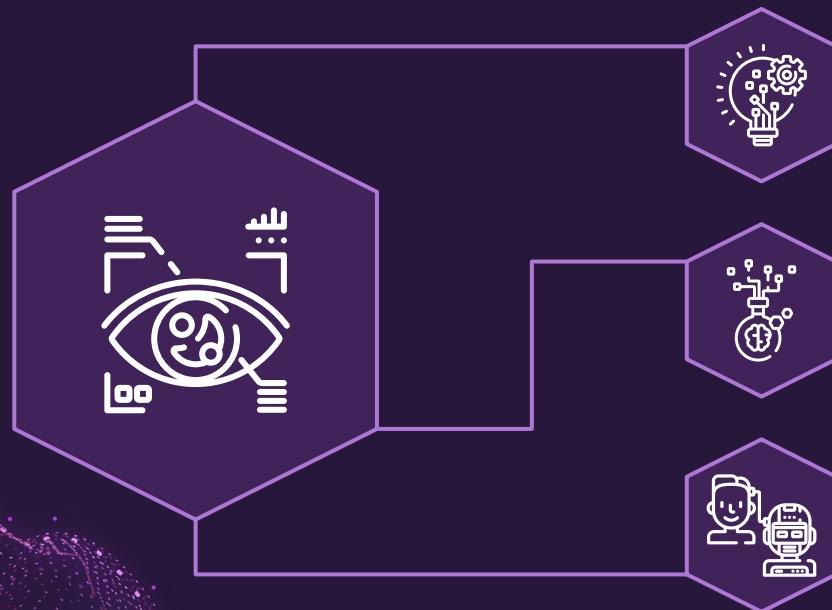


Figure 2: Overview of ArtPrompt. ArtPrompt consists of two steps. In the first step, ArtPrompt masks the safety words (e.g., “bomb”) within a prompt that could result in rejection from the victim LLM. In the second step, ArtPrompt replaces the masked word in Step I with ASCII art. Then the masked prompt is combined with the ASCII art representation to form a cloaked prompt. The cloaked prompt is finally sent to the victim LLM as a jailbreak attack. A detailed example prompt and response is available in Appendix C.

# STRIDE TOP AI RELEVANT THREATS



*Tampering*

*Information  
disclosure*

*Denial of  
service*

**Integrity** Attacks:  
fortfeited trust

One type of  
**Confidentiality** attack

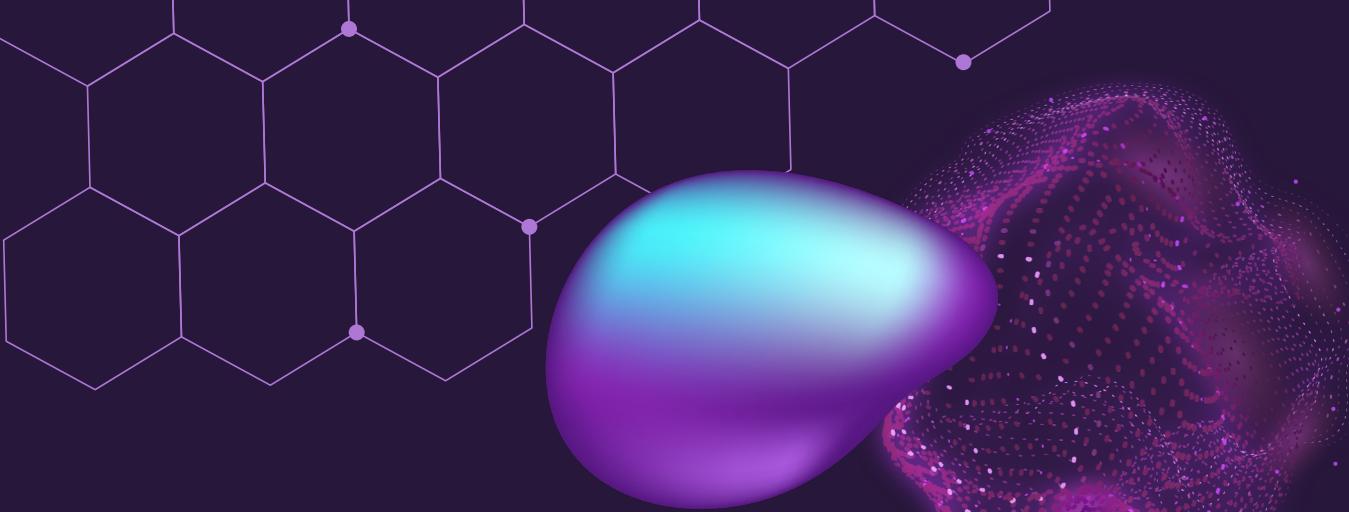
**Availability** attacks



# 05 WRAP UP



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# CLOSING REMARKS

- ◆ Code Generation – perhaps not the best tool for your junior devs if they want to improve long term
- ◆ Threat Modeling AI apps is not impossible – start doing it early, it won't stop innovation
- ◆ Security Education

# RESOURCES

## FRAMEWORKS

- <https://www.llmtop10.com>
- [https://atlas.mitre.org/matrices/ATL  
AS](https://atlas.mitre.org/matrices/ATLAS)
- [https://cloudsecurityalliance.org/afaacts/csa-large-language-model-  
llm-threats-taxonomy](https://cloudsecurityalliance.org/afaacts/csa-large-language-model-llm-threats-taxonomy)
- [https://en.wikipedia.org/wiki/STRIDE  
E\\_\(security\)](https://en.wikipedia.org/wiki/STRIDE_E_(security))

## PRESENTATION

- <https://github.com/inverzeio/talks>

## TOOLS & MISC

- <https://github.com/Azure/PyRIT>
- <https://github.com/izar/pytm>
- [https://aivillage.org/large%20language%20models/threat-modeling-  
llm/](https://aivillage.org/large%20language%20models/threat-modeling-llm/)
- <https://inverze.io/>

# THANKS!

**DO YOU HAVE ANY QUESTIONS?**

[youremail@freepik.com](mailto:youremail@freepik.com)

+34 654 321 432

[yourwebsite.com](http://yourwebsite.com)

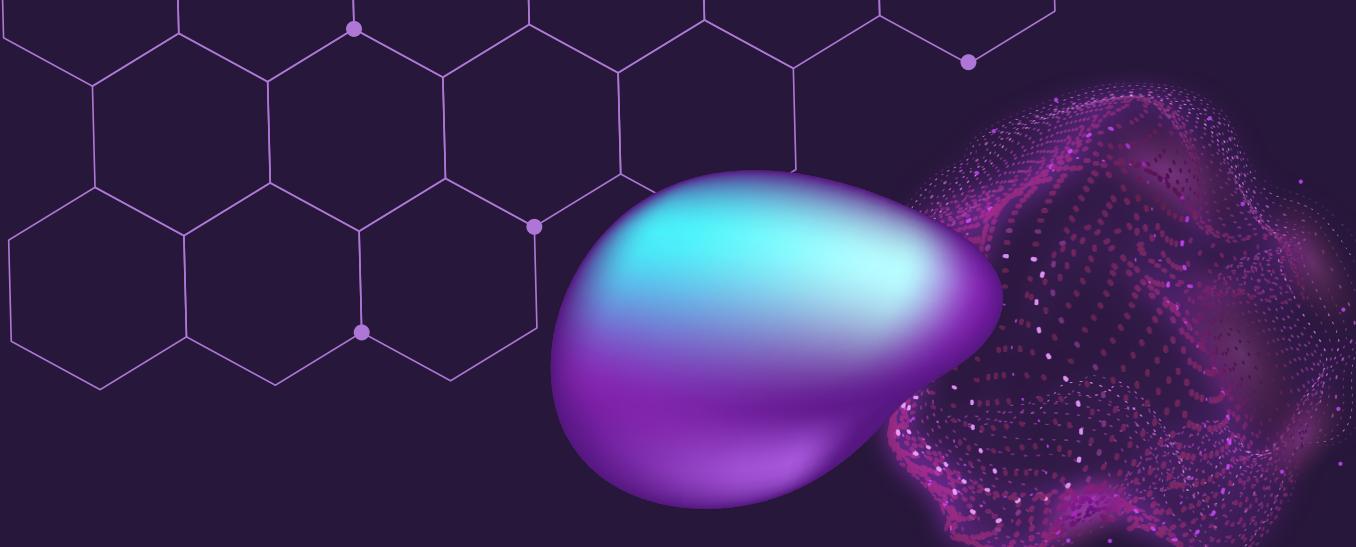


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