

# Using Artificial Intelligence in Software Engineering

Adrian Iftene

January 13, 2026

# Content

- ▶ Artificial Intelligence in Software Engineering
  - ▶ Project Requirements
  - ▶ Software Design
  - ▶ Coding
  - ▶ Testing
  - ▶ Deployment
  - ▶ Project Management
- ▶ Students Projects
- ▶ Positive/Negative Effects
- ▶ Future Work

# Artificial Intelligence in SE



- ▶ ARTIFICIAL intelligence is making the process of designing, developing, and deploying software **faster, better, and cheaper**
- ▶ **It's not that programmers are being replaced by robots**
- ▶ AI-powered tools are making project managers, business analysts, software coders, and testers **more productive and more effective**, enabling them to produce **higher-quality software faster at lower cost**

# AI in SE - Signals



- ▶ **47% of digitally mature organizations** said they have a defined AI strategy
- ▶ **Large and small software vendors** have launched dozens of AI-powered software development tools over the last 18 months
- ▶ **Startups offering AI-powered software development tools** raised **US\$704 million** over the 12 months ending September 2019
- ▶ **The global market for custom application development services** is forecast to grow from **US\$47 billion** in 2018 to more than **US\$61 billion** in 2023
- ▶ Due to increasing demand for software, **employment of software developers** is projected to grow **21 percent** from 2018 to 2028, much faster than the average for all occupations

# From big data to better software

## - Impact of AI

The Role of  
**BIG DATA** IN  
SOFTWARE DEVELOPMENT



Image hosted by WittySparks | Image source FreePik

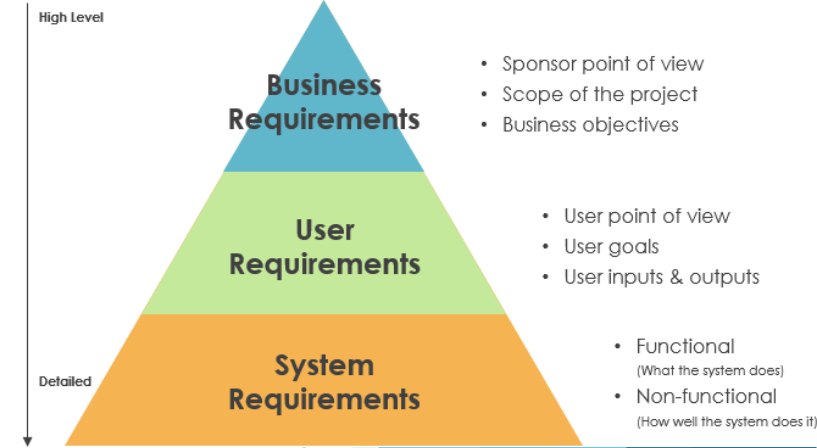
- ▶ Reducing the number of keystrokes developers need to type by half
- ▶ Catching bugs even prior to code review or testing
- ▶ Automatically generating half of the tests needed for quality assurance
- ▶ Open-source lowered the cost of software development by allowing developers to reuse and build upon others' work
- ▶ **96 percent** of commercial applications used open-source components

# Open-source Software Powered by AI



- ▶ The volume of open-source software available for use by any developer is enormous and growing rapidly
- ▶ Machine learning and natural language processing can be used to analyze source code, records of project schedules, delays, and application defects and their fixes
- ▶ A new generation of AI-powered tools is thus emerging, guiding and empowering software professionals to produce **better requirements documents, write more reliable code, and automatically detect bugs and security vulnerabilities**

# Project Requirements



- ▶ Digital assistants can analyze requirements documents, flag ambiguities and inconsistencies, and suggest improvements
- ▶ These tools are powered by natural language processing
- ▶ These tools can detect **inaccuracies** or **incomplete requirements**, **immeasurable quantification (missing units or tolerances)**, **compound requirements**
- ▶ Enterprises using such tools have been reportedly able to **reduce requirements review time by over 50 percent**
- ▶ IBM Requirements Quality Assistant

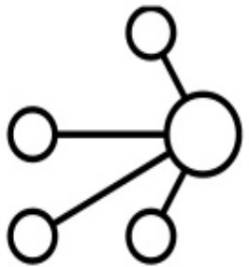
# IBM Requirements Quality Assistant

## IBM Requirements Quality Assistant

Power your engineers with Watson IoT and Requirements Quality Assistant

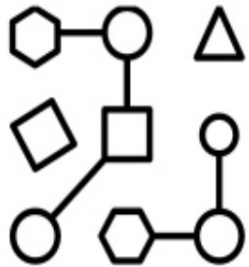
Our approach: *Pre-train Watson for you*

Watson Services



Watson Natural Language Understanding

+



Architecture and pre-built NLP model – ability to tweak for your needs w/ IBM services team

+



Requirements Public Domain Data



Customer Solution



IBM Requirements Quality Assistant

- Grades requirements against a criteria that was designed to be consistent with the INCOSE Guidelines for Writing Good Requirements
- Pre-trained to detect 10 quality issues
  - Unclear actor or user
  - Compound requirement
  - Negative requirements
  - Escape clause
  - Missing units
  - Missing tolerances
  - Ambiguity
  - Passive
  - Incomplete requirements
  - Unspecific quantities
- Add to the list of quality issues or do deeper training through a 3 week services engagement with IBM services team

# IBM Requirements Quality Assistant - 10 quality issues

Quality Issue	Guidance
Unclear actor	Pronouns such as “it,” “they,” or “them” refer to other nouns. The noun that a pronoun refers to can be unclear. To increase clarity and precision, <b>repeat the noun instead of using a pronoun.</b>
Compound requirement	This requirement includes more than one statement, actor, or action. Effective requirements are <b>single and atomic.</b> To make the requirement more precise and easier to verify, refine it to a single statement with one actor and action.
Negative statement	This requirement includes a negative statement. Effective requirements use positive statements because they are more direct, easier to verify, and less likely to be duplicated. <b>Rewrite the requirement to state what should happen, not what shouldn’t happen.</b>
Imprecise verb	Statements with verbs such as “be able to” or “be capable of” are broad and difficult to verify. For example, a system might be able to do something, but might not do it consistently. Effective requirements include a specific action that can be conclusively verified. Broad statements are appropriate in capability requirements. In system requirements, <b>replace imprecise verbs with specific and measurable actions.</b>
Escape clause	This requirement includes a phrase such as “when possible,” “if necessary,” or “as required” that makes the requirement unclear and difficult to verify. Effective requirements use specific wording that can be interpreted only one way. <b>Eliminate or replace phrases that are unclear or provide loopholes</b>

# IBM Requirements Quality Assistant - 10 quality issues (2)

Quality Issue	Guidance
Missing unit	This requirement has a value with a missing or unclear unit of measurement. Effective requirements are specific and measurable. <b>Ensure that numbers and values include a unit of measurement, and that the same units of measurement are used consistently across all requirements.</b>
Missing limits	This requirement has a value with missing or unclear limits. <b>Effective requirements state specific boundaries so that results are easier to measure and verify.</b> For example, instead of stating “The water station shall maintain the flow of water at 150 liters per second for 20 minutes,” include limits such as “The water station shall maintain the flow of water at 150 ±20 liters per second for greater than 20 minutes” to show exactly which values are acceptable.
Unclear term	This requirement includes a term that makes the requirement unclear. Effective requirements use specific and precise terms that have only one interpretation. <b>Replace vague and general terms with specific, descriptive terms.</b>
Unspecific quantity	This requirement includes a general or unspecific quantity that makes the requirement unclear. Effective requirements include clear and specific quantities. <b>Ensure that all quantities are precise.</b> For example, instead of stating “The system shall use minimum power,” specify what “minimum” means.
Incomplete requirement	This requirement is incomplete because the actor, action, object or imperative is missing. <b>Rewrite the requirement to clearly identify the object of the action.</b>

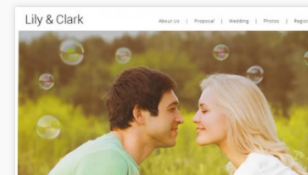
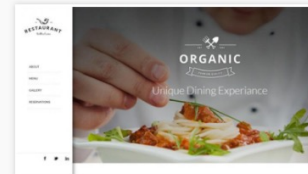
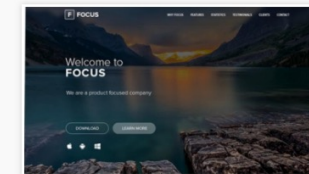
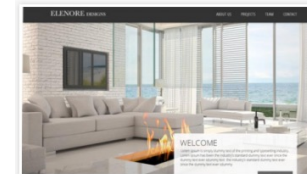
# Software design

- ▶ Planning a project and designing it from scratch need designers to apply their specialized learning and experience
- ▶ A designer begins with a vision of the solution, and after that retracts and forwards investigating plan changes until they reach the desired solution
- ▶ Along this line, a few AI developments have demonstrated the advantages of enhancing traditional methods with intelligent specialists
- ▶ For instance, take the example of AIDA - The Artificial Intelligence Design Assistant, deployed by Bookmark. **AIDA** understands a users needs and desires and uses this knowledge to create an appropriate website for the user
- ▶ It makes selections from millions of combinations to create a website style, focus, image and more that are customized for the user



AWARD - WINNING DESIGNS

LET AIDA CREATE YOUR WEBSITE IN LESS THAN TWO MINUTES





# bayou

```
out = new  
BufferedWriter  
(new FileWriter("hello",  
true));out.write("world");  
catch(IOException e){// ...}  
finally {if (out != null)  
{out.close();}}
```

0 references | 0 changes | 0 authors, 0 changes

```
39 public static void CreateTable()  
40 {  
41     using (var context = new TaskContext())  
42     {  
43         context.Database.ExecuteSqlRaw("CREATE TABLE tasks (id INT PRIMARY KEY, title VARCHAR(50), priority INT);");  
44     }  
45 }  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59 }  
60
```

I

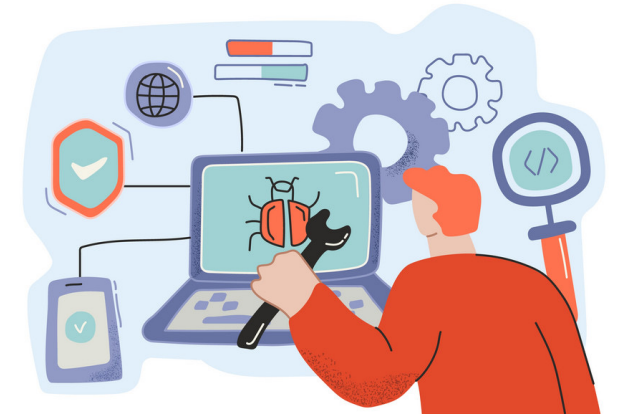
# Chat GPT - Object Oriented Programming

- ▶ In a hospital we have doctors, nurses and patients. Create the necessary classes to be able to manage the following information: We have two doctors (Doctor1 (Heart) and Doctor2 (Lung)) and three patients (Patient1 (Heart), Patient2(Lung), Patient3(Heart, Lung)). Create objects necessary to manage the above information and display all available details about doctors and patients.

```
class Person {
    private String name;
    public Person(String name) {
this.name = name;}
    public String getName() {
return this.name;}
}
class Doctor extends Person {
    private String specialization;
    public Doctor(String name, String specialization) {
super(name);
```

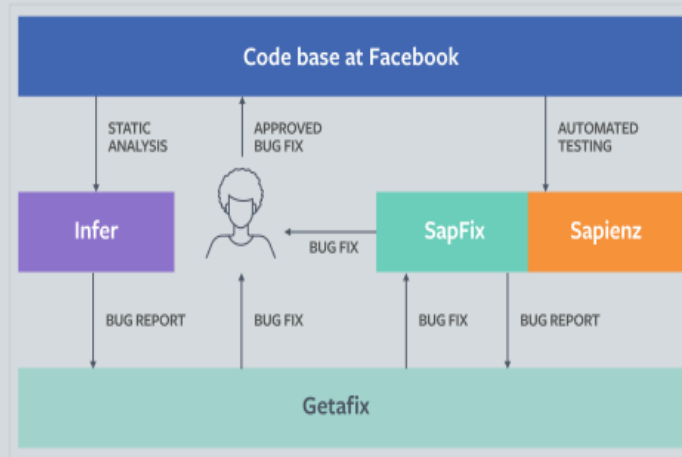
```
this.specialization = specialization;}
    public String getSpecialization() {
return this.specialization;}
}
class Patient extends Person {
    private String[] conditions;
    public Patient(String name, String[] conditions) {
super(name);
this.conditions = conditions;}
    public String[] getConditions() {
return this.conditions;}
}
```

# Review, bug detection, and resolution

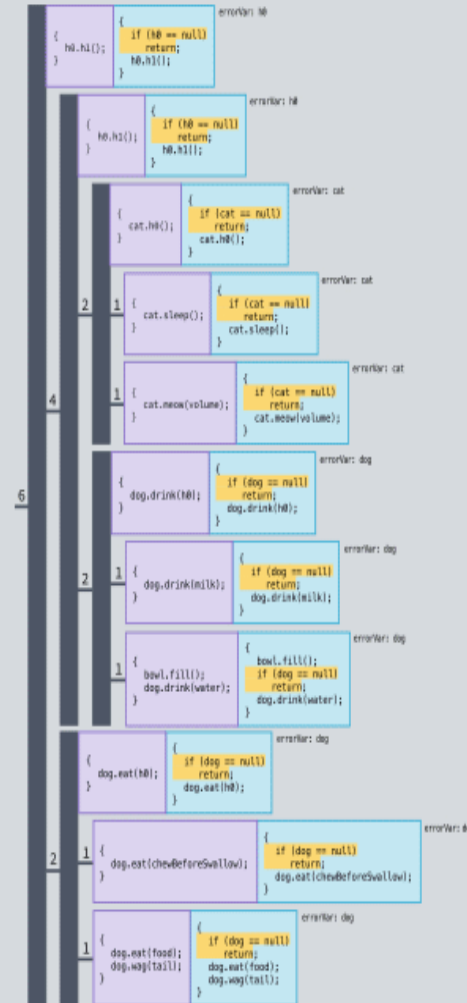


- ▶ Code-review tools use AI to automatically detect bugs and suggest code changes by understanding the intent of the code **and identifying common mistakes and their variants**
- ▶ At Facebook, Getafix predicts defects and suggests remedies that are thus far **proving correct 80 percent of the time**
- ▶ Getafix learns from engineers' past code fixes, its recommendations are intuitive for engineers to review
- ▶ The cost of fixing bugs rises considerably further down the software life cycle, as reproducing the defects in a developer's local environment can be complex and business-critical services failure can be costly
- ▶ Video game company Ubisoft says the use of machine learning is helping it **catch 70 percent of bugs prior to testing**

# Getafix: How Facebook tools learn to fix bugs automatically



Getafix uses a more powerful clustering algorithm and also analyzes the context around the particular lines of problematic code to find more appropriate fixes



# Getafix - Examples

```
20 public boolean onBackPressed() {  
21     ApplicationContext ctx = this.getContext();  
22     return ctx.onBackPressed();  
23 }  
24
```

 phabricatorlinter suggested changes to line 22

The value of `ctx` in the call to `onBackPressed()` could be null. (Origin: call to `getContext()` at line 21).

Questions about this suggested fix? [Post in Getafix Feedback](#)

Lint code: INFER

Lint name: Null Method Call

```
+   if (ctx == null) {  
+       return false;  
+   }  
    return ctx.onBackPressed();
```

10 minutes ago • Like • Reply • Resolve

[Accept](#) • [Reject](#)

```
50 public void onDestroyView() {  
51     mListView.clearListeners();  
52     mListView = null;  
53 }
```

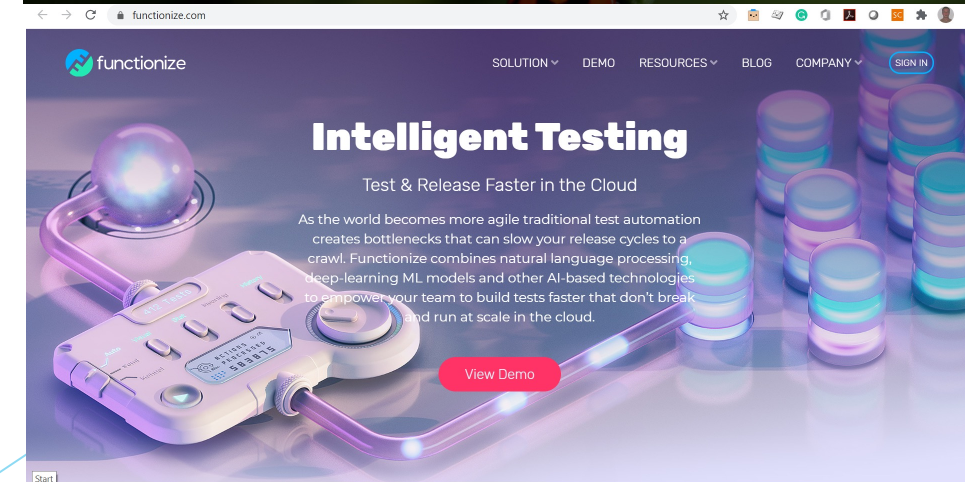
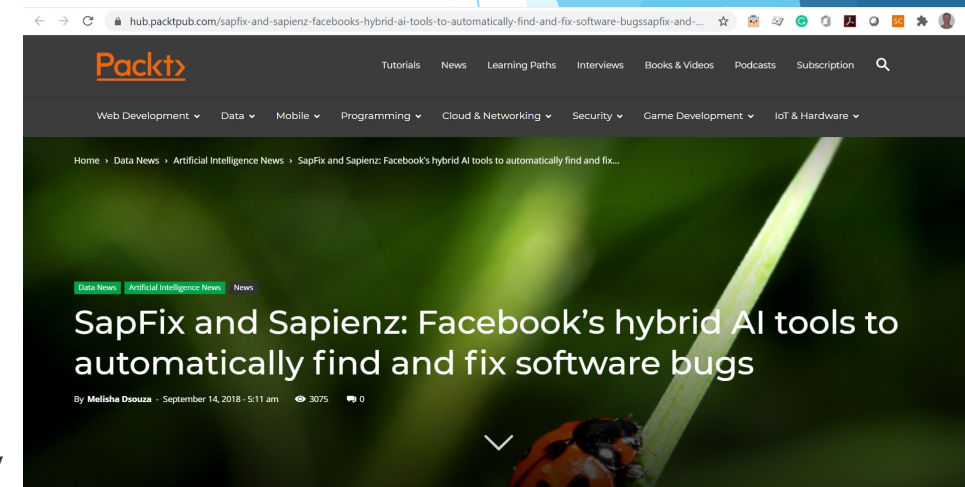
$h_0 \mapsto mListView$

$h_1 \mapsto clearListeners$

```
50 public void onDestroyView() {  
51     if (mListView == null)  
52         return;  
53     mListView.clearListeners();  
54     mListView = null;  
55 }
```

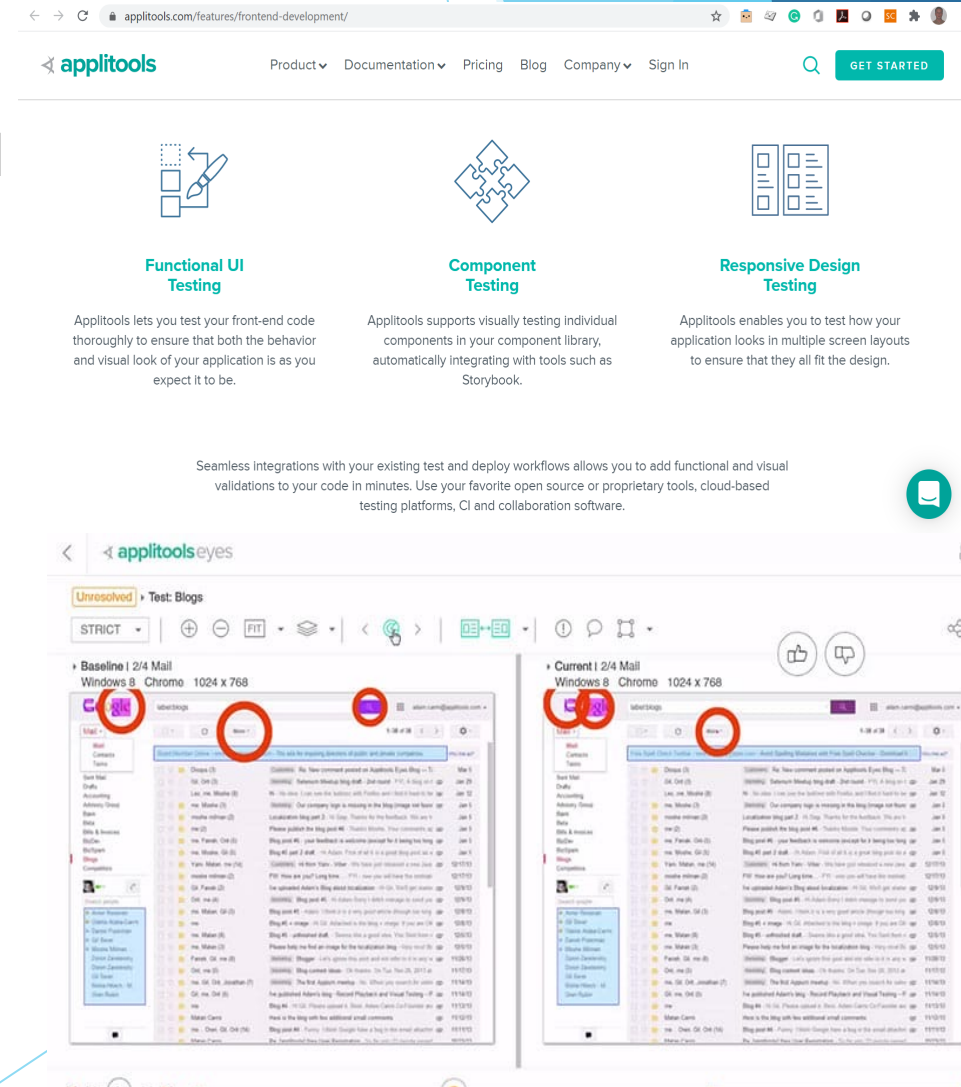
# More thorough testing

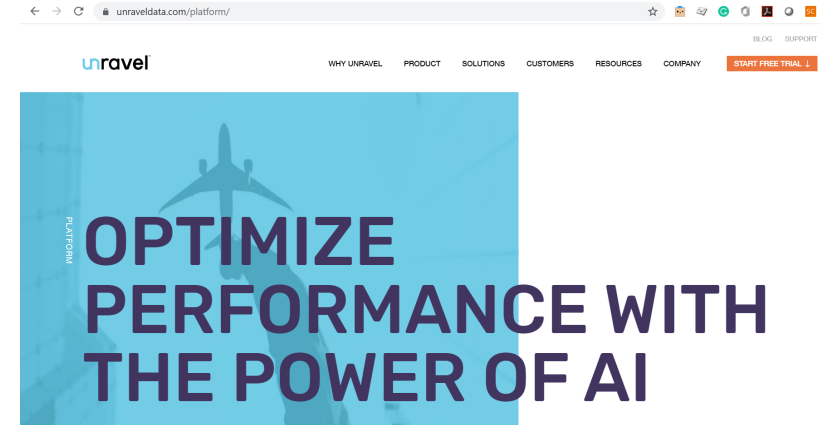
- ▶ AI has made it possible not only to run tests automatically but to automatically generate the test cases
- ▶ An AI-powered tool automatically generate over half of the test cases
- ▶ Another tool is able to adapt to UI changes by identifying elements by their functionality and not just their position on the screen. The tool achieved the same test coverage as with its older testing tool in a smaller fraction of the time



# GUI Testing

- ▶ With very few tools and techniques available to aid in the testing process, **testing GUIs is difficult**
- ▶ Currently used GUI testing methods are **ad hoc** and now that is a lot of manual work
- ▶ Also, not forgetting that if the **GUI is modified after being tested**, the test designer must change the test suite and perform **re-testing**
- ▶ **Applitools** is a GUI tester tool empowered by AI
- ▶ It allows users to keep track of both the **web page behaviour**, as well as the **look of the webpage**





# Deployment

- ▶ AI-powered tools are helping to **predict deployment failure ahead of time**
- ▶ This can **speed up root cause analysis and recovery in case of a failure**
- ▶ An e-commerce company attain **faster application delivery and a 75 percent reduction in mean-time-to-restore from a failure in the production environment**
- ▶ AI can even help applications **run optimally while in production**
- ▶ Another online company deployed a machine learning-based tool that **automatically deploys optimal environment configurations**
- ▶ This helped them **halve cloud costs and more than double application performance**

# Project management

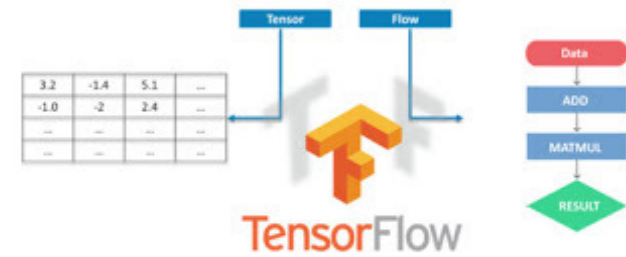
- ▶ Tools to predict the technical tasks, engineering resources, and timelines that new software projects will require
- ▶ This can make project planning more accurate and project execution more efficient
- ▶ As an example, the innovation team at French telco Orange deployed an AI-powered project management tool to automate the long, manual process of updating project timelines with changes in project scope or feature sets

The screenshot shows the TARA website header with navigation links: 'How it Works', 'Release Log', 'About Us', 'We're hiring!', 'Sign In', and a 'Get Tara for Free' button. The main heading reads 'Finally, a platform that helps you answer: When is our next product release?'. Below this, a paragraph states: 'By connecting Git to tasks and sprints, Tara helps everyone on your team have clarity around the release cycle, from engineering to sales. No more wading through tickets to view progress.'

A section titled 'Built for efficiency' features a checkmark icon and the text: 'Requirements and tasks, in one view. Engineers can now view the technical spec and related tasks in one scroll.' To the right, a partial view of a software interface is shown, displaying a 'File Attachment V2.0' card with 'Objective' and 'Task' sections, and a table with columns 'TASK' and 'DESC'.

# Tools

- ▶ **TensorFlow** is an open source, numerical computational tool. This ML library is primarily for production and research.
- ▶ **H2O.AI** for insurance, banking, marketing, telecom and healthcare. It will allow one to use Python and R for building models
- ▶ **Cortana** is a virtual assistant which provides many featured skills. Also its' voice recognition feature proves to be a time saver
- ▶ **IBM Watson** is a question answering software. IBM Watson is robust system which assists in making business processes smarter

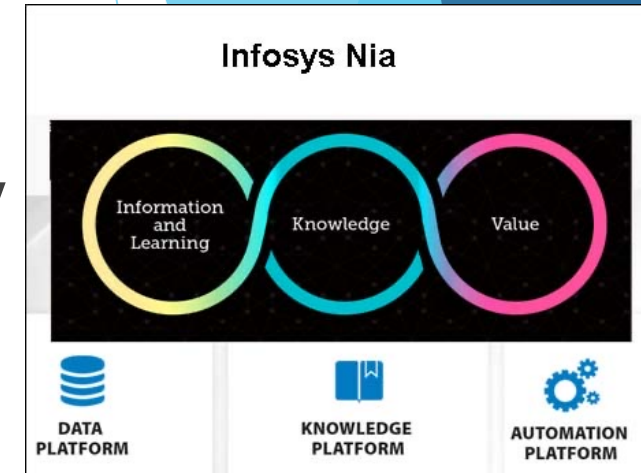


The screenshot shows the Cortana Skills Kit page. It features a large blue circle graphic. The main heading is 'Cortana's got skills'. Below it, there's a 'CREATE A SKILL' button. The page also includes a section 'Build amazing skills using the Cortana Skills Kit' with icons for various skills like 'Cortana Skills for Enterprise', 'Have conversations with your users', 'Create customized skills with Cortana's profile', and 'Stream audio to your users'.

The screenshot shows the Analytics Insight page. It features a large blue and yellow globe graphic. The main heading is 'How to Create Your First Chatbot Using IBM Watson in 30 Minutes'. The page also includes the Analytics Insight logo.

## Tools (2)

- ▶ **Infosys Nia** accumulates organizational data on the legacy system and can create high performing, scalable models
- ▶ **Deeplearning4j** is a plug-and-play AI software for faster prototyping
- ▶ **Google Assistant** is a virtual assistant by Google which can be utilized on smartphones and smart home devices



DL4J  
DEEPLARNING4J

```
0000000000
1111111111
2222222222
3333333333
4444444444
5555555555
6666666666
7777777777
8888888888
9999999999
```



Google  
ASSISTANT

Hi, how can I help?

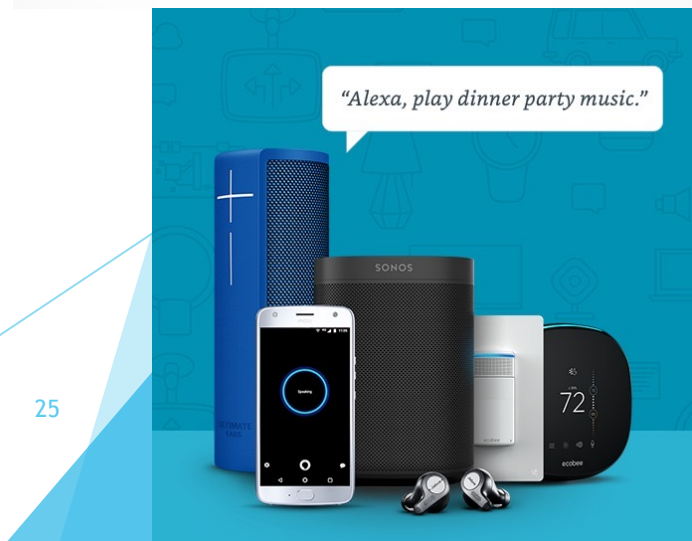
# Student Projects

## ▶ Similar projects from github:

- ▶ For a new project description search on github similar projects with similar description (Lucene - index readme files)
- ▶ For similar projects extract source code files and generate class diagrams (reverse engineering for Java)
- ▶ Identify common classes and come with a “proposal” of “start solution” for the new project

## ▶ Voice interface for mobile applications

- ▶ Platform that allow to add very easy to a mobile application voice interaction capabilities for Romanian (Amazon platform)



# Positive Effects



- ▶ AI and software intelligence tools aim to make **software development faster, easier, more efficient, more effective, and less costly**
- ▶ AI-enhanced software development tools are an opportunity to **increase the output's velocity and quality**
- ▶ Enable professionals without computer science or software engineering training to develop applications
- ▶ These platforms have begun to include AI-enabled capabilities to **make it easier and more efficient to create and test applications**

# Downside Effects

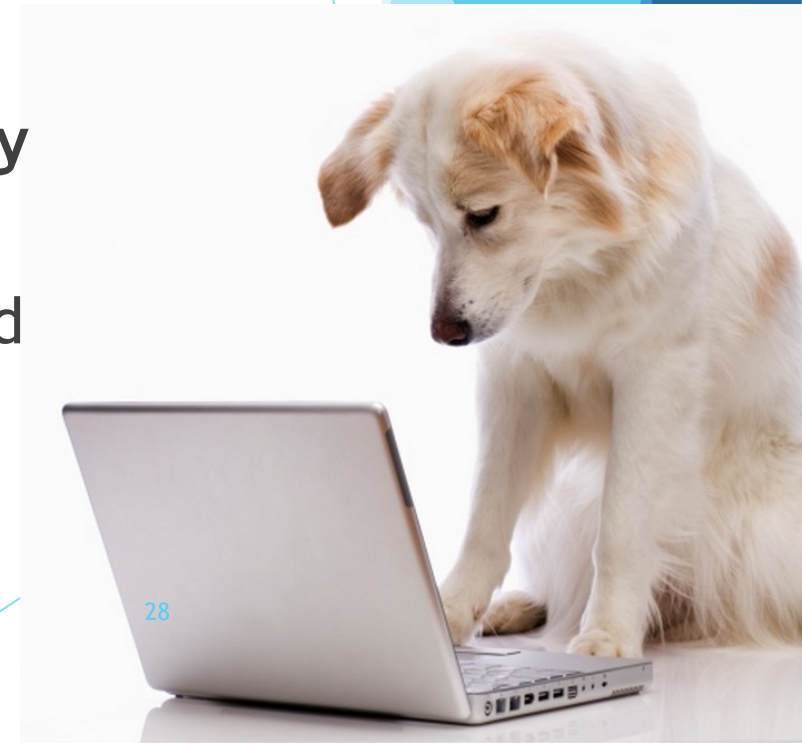


- ▶ **Tools trained on open-source projects could encourage developers to inadvertently propagate bugs and security risks into their code**
- ▶ **And teams deploying code recommendation tools could see productivity dip before improving, as those tools may require some usage and training before reliably generating highly accurate recommendations**

# The future of software development



- ▶ Pundits have long predicted the end of programming
- ▶ Some have forecasted that computers would eventually write their own programs; others have suggested that the task of programming computers will give way to a process of teaching computers, by means of machine learning
- ▶ AI-enhanced software development tools are a good example of how AI can empower, rather than replace workers



# Bibliography

- ▶ Cioffi, R., Travaglioni, M., Piscitelli, G., Petrillo, A., De Felice, F. (2020) *Artificial Intelligence and Machine Learning Applications in Smart Production: Progress, Trends, and Directions*. Sustainability 2020, 12, 492; doi:10.3390/su12020492
- ▶ Feldt, R., de Oliveira Neto, F. G., Torkar, R. (2018) *Ways of Applying Artificial Intelligence in Software Engineering*. arXiv:1802.02033v2 [cs.SE] 7 Feb 2018
- ▶ Harman, M. (2012) *The Role of Artificial Intelligence in Software Engineering*. 2012 First International Workshop on Realizing AI Synergies in Software Engineering (RAISE).
- ▶ Marques, J., Yelisetty, S. (2019) *An analysis of software requirements specification characteristics in regulated environments*. International Journal of Software Engineering & Applications (IJSEA), Vol.10, No.6, November 2019, DOI: 10.5121/ijsea.2019.10601
- ▶ Meziane, F., Vadera, S. (2010) *Artificial Intelligence in Software Engineering. Current Developments and Future Prospects*. Information science reference. Hershey • New York

# Links

- ▶ Chandler, S. (2020) How AI Is Making Software Development Easier For Companies And Coders. Forbes, Innovation. <https://www.forbes.com/sites/simonchandler/2020/02/05/how-ai-is-making-software-development-easier-for-companies-and-coders/#35e67aa26641>
- ▶ Chandra, S., Bader, J., Lippert, E., Scott, A. (2018) Getafix: How Facebook tools learn to fix bugs automatically. facebook Engineering. DEVELOPER TOOLS, ML APPLICATIONS <https://engineering.fb.com/developer-tools/getafix-how-facebook-tools-learn-to-fix-bugs-automatically/>
- ▶ Dsouza, M. (2018) 5 ways artificial intelligence is upgrading software engineering. Packtpub. Artificial Intelligence News. <https://hub.packtpub.com/5-ways-artificial-intelligence-is-upgrading-software-engineering/>
- ▶ Apoorv Gehlot (2019) AI Development Tools Make Software Development Easier. Technative. AI & Machine Learning <https://www.technative.io/ai-development-tools-make-software-development-easier/>
- ▶ Schatsky, D., Bumb, S. (2020) AI is helping to make better software. Professionals are using artificial intelligence for help in design, development, and deployment. Deloitte Insights. <https://www2.deloitte.com/us/en/insights/focus/smart-for-strategists/ai-assisted-software-development.html>
- ▶ Brad Middleton (2018) Power your engineers with Watson IoT and Requirements Quality Assistant <https://www2.slideshare.net/BradMiddleton3/power-your-engineers-with-watson-iot-and-requirements-quality-assistant>

For the presence,  
patience,  
collaboration ...

