AGENDA

ABOUT ME

MOTIVATION: REDEFINING TEST AUTOMATION

BACKGROUND: AI, MACHINE LEARNING, TESTING

AI-DRIVEN TESTING: A NEW ERA OF TEST AUTOMATION

CONCLUSION
AUTOMATION
MACHINES WORKING WITHOUT DIRECT HUMAN CONTROL

**au·to·ma·tion**

/ˌə́dəˈmɑː̃ʃ(ə)n/ noun

1. Capable of starting, operating, and completing independently.
2. Use of various control systems for operating machinery and equipment with minimal human intervention.
GRAND VISION OF SOFTWARE TESTING, NO HUMAN INTERVENTION

AUTONOMOUS, AHDRIVEN EXPLORATION AND TEST GENERATION

AIST

ARTIFICIAL INTELLIGENCE FOR SOFTWARE TESTING

Ultimate SOFTWARE

AISTA
Artificial Intelligence for Software Testing (AIST) is an emerging field aimed at the development of AI systems to test software, methods to test AI systems, and ultimately designing software that is capable of self-testing and self-healing.
artificial intelligence:

1. a branch of computer science dealing with the simulation of intelligent behavior in computers

2. the capability of a machine to imitate intelligent human behavior
INTELLIGENT AGENT
AN AUTONOMOUS ENTITY THAT CAN...

Perceive and act in its environment using sensors and actuators, respectively.

Direct its activity toward goals and use knowledge and learning in achieving those goals.

Analyze itself in terms of behavior, error, and success and adapt online, possibly in real time.

Be organized with other agents, typically in a hierarchy to tackle problems at different abstraction levels.

Typically referred to as bots or AI.
machine learning:
The science of getting computers to act without being explicitly programmed.

If a program can improve how it performs a certain task based on previous experience then you can say the program has learnt.
If the performance $P$ of a computer program at completing a task $T$ improves with experience $E$, the program is said to learn from experience $E$. 
software testing:
dynamic program verification using finite tests from an infinite execution domain
Is $f(d)$ acceptable?
T is successful iff $\forall t \in T \ OK(t)$

T is an ideal test iff $\forall t \in T \ OK(t) \rightarrow \forall d \in D \ OK(d)$
Software Complexity

Conventional Test Coverage

Time

Complexity / Coverage

Software Complexity

AI-Driven Test Coverage

Conventional Test Coverage

Time

Complexity / Coverage

Source: AI for Software Testing, Jason Arbon, CEO, test.ai
https://www.linkedin.com/pulse/ai-software-testing-jason-arbon
AI-DRIVEN TESTING
FAD, FICTION, OR FUTURE?

- mabl
- test.ai
- applitools
- SOFY.AI
- diffblue
- eggplant
- AppTest.ai
- functionize
- testrigor
- testim
- AutonomIQ
AI-DRIVEN TESTING
A NEW ERA OF TEST AUTOMATION

INTERACT
Generate actions to navigate through the application UI, input data, and verify observable outcomes.

LEARN
Direct feedback on the quality of an agent's actions to help improve future actions.

MODEL
Keep track of the application and environment state to help deal with uncertainty and partial observability.

EXPLORE
Perceive the environment including the application UI structure, behavior, and any differences over builds.

APPRAoch
HOW BOTS LEARN TO TEST SOFTWARE
APPREACH
HOW BOTS LEARN TO TEST SOFTWARE

ARCHITECTURE
DEMYSTIFYING AI-DRIVEN TESTING BOTS

AI-DRIVEN TEST BOT

MAPE + KML

SEEDED BASE KNOWLEDGE
ACQUIRES NEW KNOWLEDGE
MAINTAINS EXISTING KNOWLEDGE
SHARES ITS KNOWLEDGE
PROTOTYPES
AI-GENERATION AND EXPLORATION IN TEST

GitHub
http://github.com/UltimateSoftware

/AGENT
/AVENT-X
FROM TEXT GENERATION TO TEST GENERATION
A LESSON LEARNED FROM ALICE IN WONDERLAND

~150,000 Characters
Total in the book

47 Distinct Characters
When converted to lowercase

100-Length Subsequence Training
N-Length Subsequence → Character Output
Example (N=5)
CHAPT → E
HAPTE → R
be no mistake about it: it was neither more nor less than a pig, and she felt that it would be quite a afin that she was a little want of tolet and a gretpensent to the tae a little war th tee the base ou teetee the had been timheg a little tole at the caii in a long twiss aedum that sheer was a little tare gereen to be a gentle of the tabdiit soenee the gaud ouw is the tag a tint of tolet at the was a little anmersen, and thiu had been wolte io a lott of tueh a tile and taede bot her aain. she cere thn the bene tish the tere bane to tee toate to tee the harter was a little tire the same oare cade an ani ano the garee and the was so seat the was a little gareen and the sabbit, and the white rabbit wese tilel an the cade and the sabbit se teeter, and the white rabbit wese tilel an the cade in a ionk tine the sabdi ano arling to tee the was of teet white the was a little tane oo thete the sabbit she was a little tartig to the tar tf tee the tamee of the oad, and the white rabbit was a little tole to be anle tite thete ofs and the tabdiit was the white rabbit, and

herself lying on the bank, with her head in the lap of her sister, who was gently brushing away so see, and she sabbit said to herself and the sabbit said to herself and the good way of the was a little that she was a little lad good to the garden, and the sood of the moek turtle said to herself: 'it was a little that the moek turtle said to see it said to sea it said to sea it say it the marge hard sat un a little that she was so seared to herself; and she sabbit said to herself: 'it was a little little shated of the sooe of the coomouse it was a little lad good to the little gooder head. and said to herself. it was a little little shated of the mouse of the good of the courte, and it was a little little shated in a little that the was a little little shated of the thmee said to see it was a little book of the was a little that she was so sealled to hare a little the began sitez of the was of the was a little that she was so seally and the sabbit was a little lad good to the little gooder head of the gud seared to see it was a little lad good to the little good
ABSTRACT TEST LANGUAGE

AI-DRIVEN TEST GENERATION
MACHINES LEARNING FROM HUMAN TESTERS

Observation: Required TextBox FirstName
Input: BLANK FirstName Invoke Submit
Observation: ErrorMessage

AI-DRIVEN TEST GENERATION
MACHINES LEARNING FROM HUMAN TESTERS

Observe Required TextBox FirstName
Input BLANK FirstName Invoke Submit
Observe ErrorMessage

IF
Perceived Conditions

WHEN
Input Actions

Observe ErrorMessage
**AI-DRIVEN TEST GENERATION**
MACHINES LEARNING FROM HUMAN TESTERS

Observe Required TextBox FirstName

**IF**
Perceived Conditions

**WHEN**
Input Actions

**THEN**
Required Observations

- **Input Sentence**
- **Predicted Next Word**

<table>
<thead>
<tr>
<th>Input Sentence</th>
<th>Predicted Next Word</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observe</td>
<td>Required</td>
</tr>
<tr>
<td>Observe Required</td>
<td>Textbox</td>
</tr>
<tr>
<td>Observe Required Textbox</td>
<td>FirstName</td>
</tr>
<tr>
<td>Observe Required Textbox FirstName</td>
<td>Input</td>
</tr>
<tr>
<td>Observe Required Textbox FirstName Try</td>
<td>VALID</td>
</tr>
<tr>
<td>Observe Required TextBox FirstName Try VALID FirstName</td>
<td>Invoke</td>
</tr>
<tr>
<td>Observe Required TextBox FirstName Try VALID FirstName Click</td>
<td>Submit</td>
</tr>
<tr>
<td>Observe Required TextBox FirstName Try VALID FirstName Click Commit</td>
<td>NotObserve</td>
</tr>
<tr>
<td>Observe Required Textbox FirstName Try VALID FirstName Click Commit NotObserve</td>
<td>ErrorMessage</td>
</tr>
</tbody>
</table>
AI-DRIVEN TEST GENERATION

KEY ADVANTAGES

GENERAL PURPOSE
Different Testing Types
Any Application or Domain

PESTICIDE FREE
Generates New Tests Each Time
Eliminates Pesticide Paradox

LARGE SCALE
Deep Learning
Cloud Infrastructure
LIMITATIONS?
SELF-TESTING
AI-DRIVEN TESTING FROM THE INSIDE-OUT

AUTONOMIC SELF-TESTING
TESTING DYNAMICALLY ADAPTIVE SYSTEMS

AI-DRIVEN TESTING

TOOLS

METHODS

TESTING AI SYSTEMS

DESIGNS

SELF-TESTING SYSTEMS
THANK YOU

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REFERENCES