

Jail, Hero or Drug Lord?

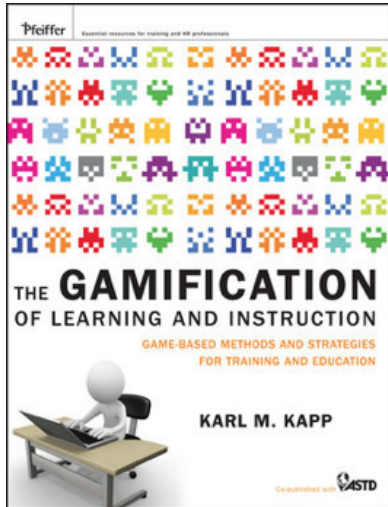
Turning a Cyber Security Course Into an 11 Week Choose
Your Own Adventure Story

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Motivation

Story/narrative is an important aspect of gamification.

In making cyber security education challenges this is often overlooked.



Introduction



Technical engine

Types of Games

5	3		7			
6			1	9	5	
	9	8				6
8			6			3
4			8	3		1
7			2			6
	6				2	8
			4	1	9	
				8		7
						9

VS



Evaluation

Story development

Examples of narrative within security training

Within competitions, the use of narrative is common

- PicoCTF used a story about helping a broken robot get home
- HackFu is set in a theatrical environment (with actors playing roles within the story!)

Intro to CS course as a campus treasure-hunt, with CTF-style challenges, puzzle-based learning, and alternate reality games (1st year undergrad)

Security and cryptography courses following Divergent storyline (school level)

Our Goal

Provide a framework to put exercises into the context of a story.

The story should tie the exercises together, for a 11 weeks cyber security course.

Students should have control over the story.

End-goal: Improve student engagement & attainment within the course.

Contribution

We have developed a choose-your-own-adventure **story engine** to add a narrative to educational CTF challenges.

We have written a story for this based on investigating a black market site (**The Cotton Highway**), in a corrupt company.



We have used this with a 2nd year cyber security class and collected data about its affect.

Tech deets

Framework

cs.bham.ac.uk

Flags submission
webservice

Logging webservice

Virtual machine

Setup script

Ex 1

Ex 2

Ex 3

Ex 4

Ex 5

Player space

Mail server

Story engine

Web server

Framework

cs.bham.ac.uk

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webserver

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Mail server

Story
emails

Story engine

Web server

From: NikAdler@sensiblefurniture.com

Subject: You know crypto, right?

427,

I'm your line manager, Nik Adler. Let's get things straight from the outset - as a cyber advisor, you're privy to a lot of information and data. I trust you will be responsible and carry out your duties with delicacy and precision.

We're having issues trying to decrypt some files - maybe you could take a look at them? We've put them in your home directory so you can get started on them.

Once you've managed to get in, each should have a cryptographic token in them. Please reply with as many of those tokens you can find. **Under no circumstances, should you relay this onto anyone else.**

N.

From: monkey.see482@imeverywhere.sensiblefurniture.com

Subject: Welcome to the doghouse. Want to see what actually goes on?

Hey!

I told those guys in IT they need to give you stronger encryption keys for email. Guess old moneybags decided it's too expensive to actually care. What do you care, anyway? You're the new cybergeek I see - what a generic term nowadays which has absolutely no context.

Who am I? You'll find out soon enough, but you need to prove yourself to me first. Why am I emailing you? Well, congratulations smarto - you bagged last place in the prize list. The guy who sat in your seat was involved in something big, but he went missing. So... what happens if one of your best goes 'away'? You replace them with someone better, or at least that's probably what HR said to you to sell the job.

This is where you come in. The email you just got from Adler? There's more context than just a simple decryption task to get you started. [...]

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flags

Player space

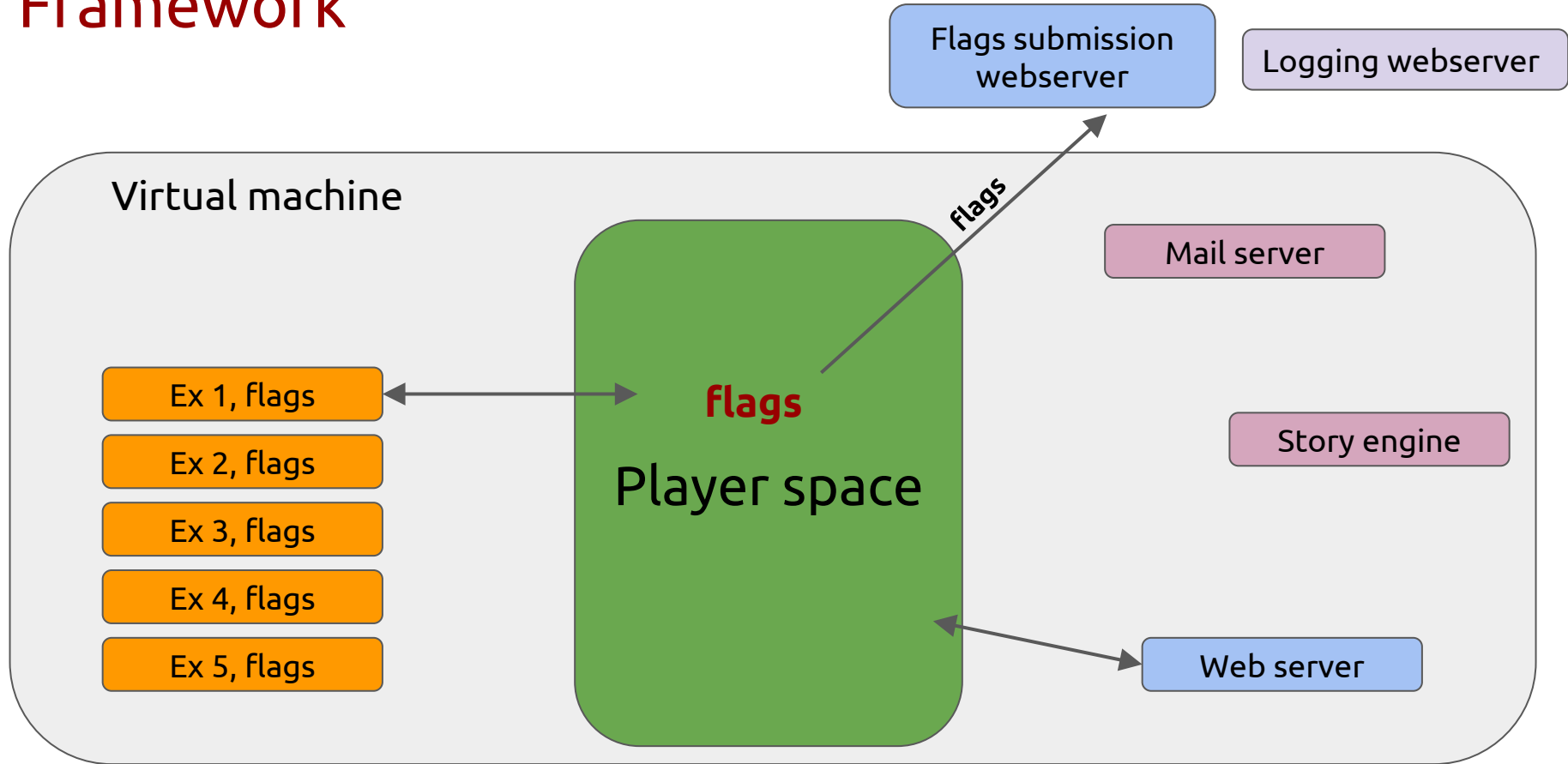
Mail server

Story engine

Web server

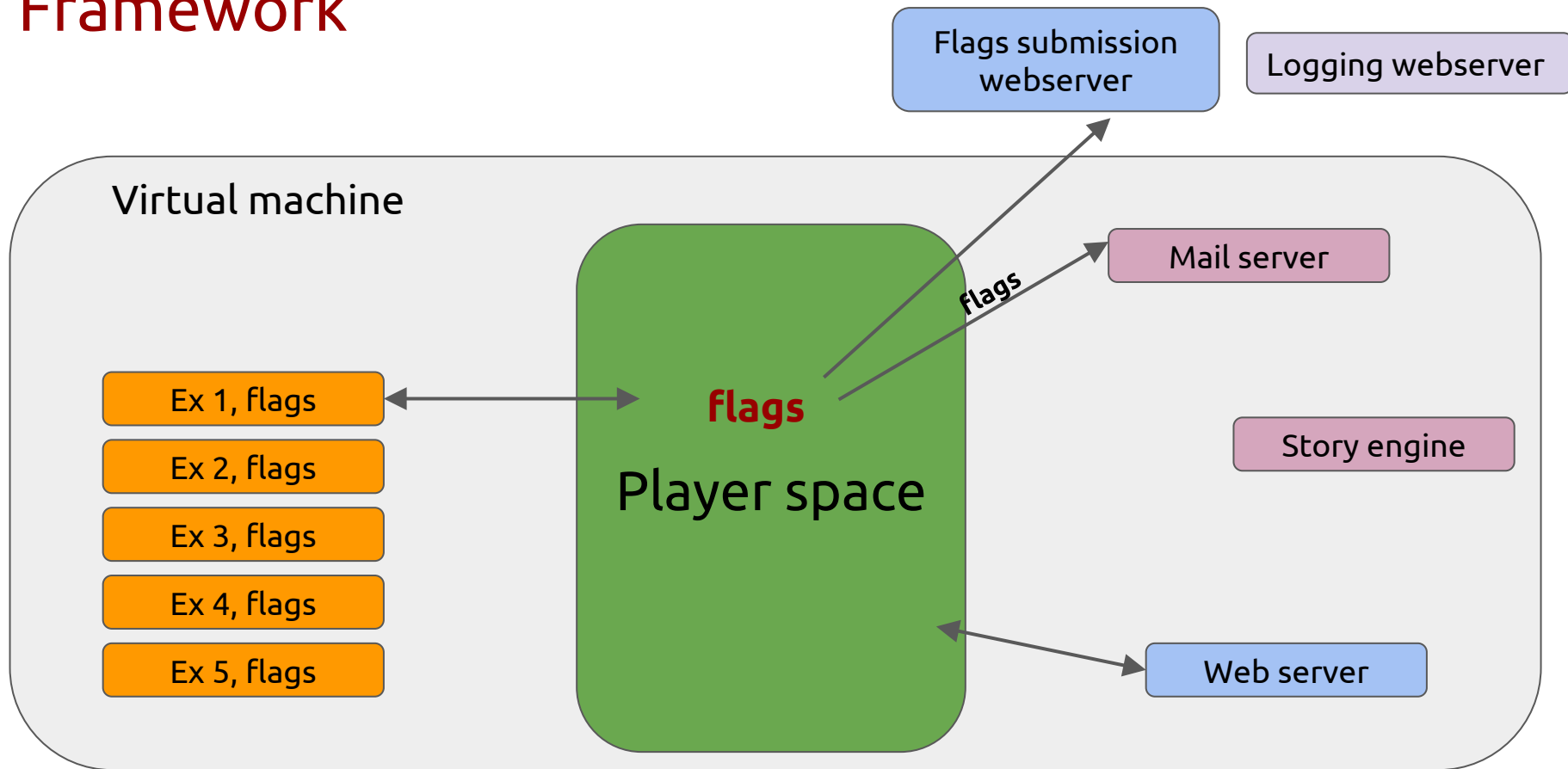
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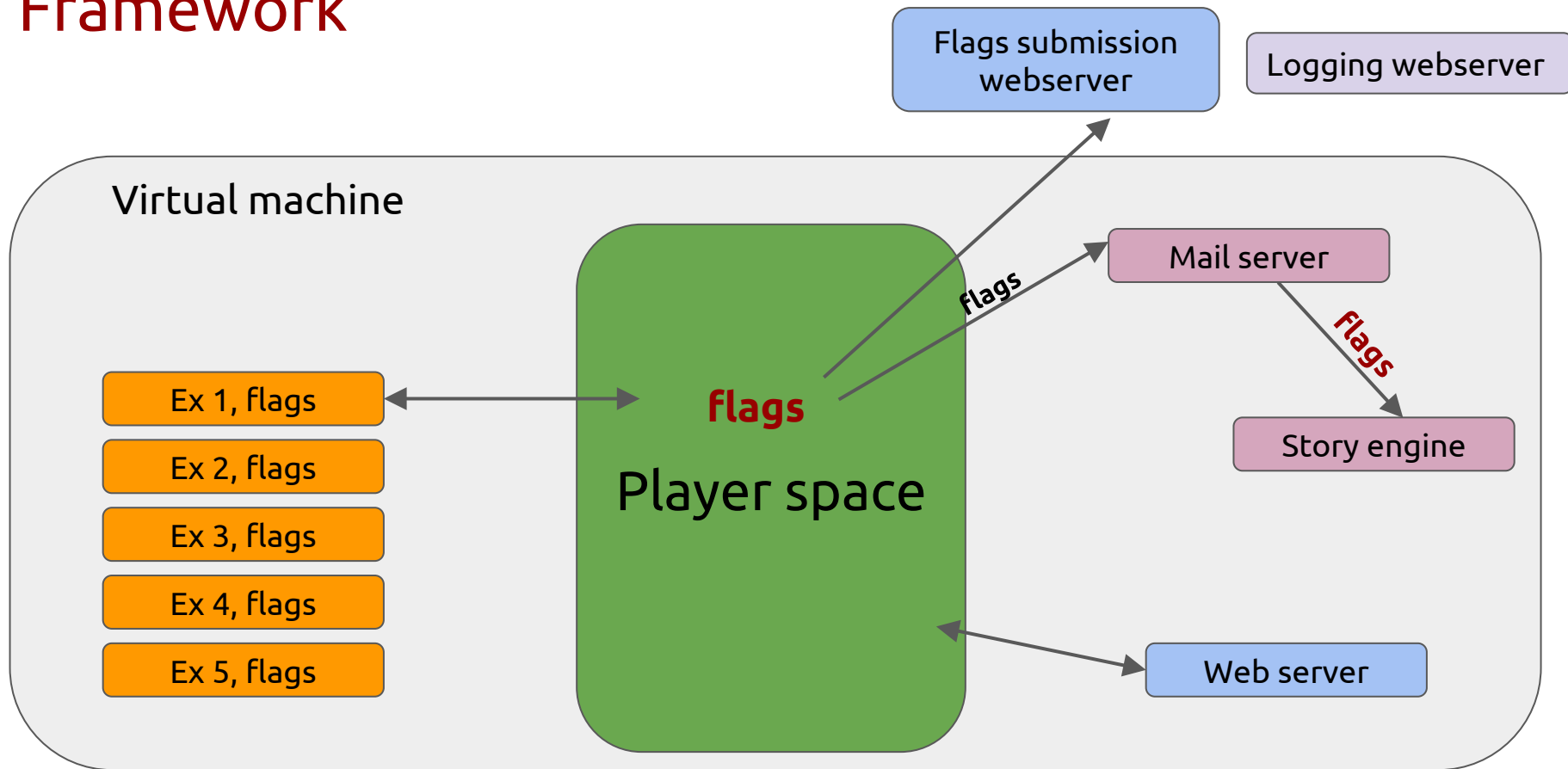
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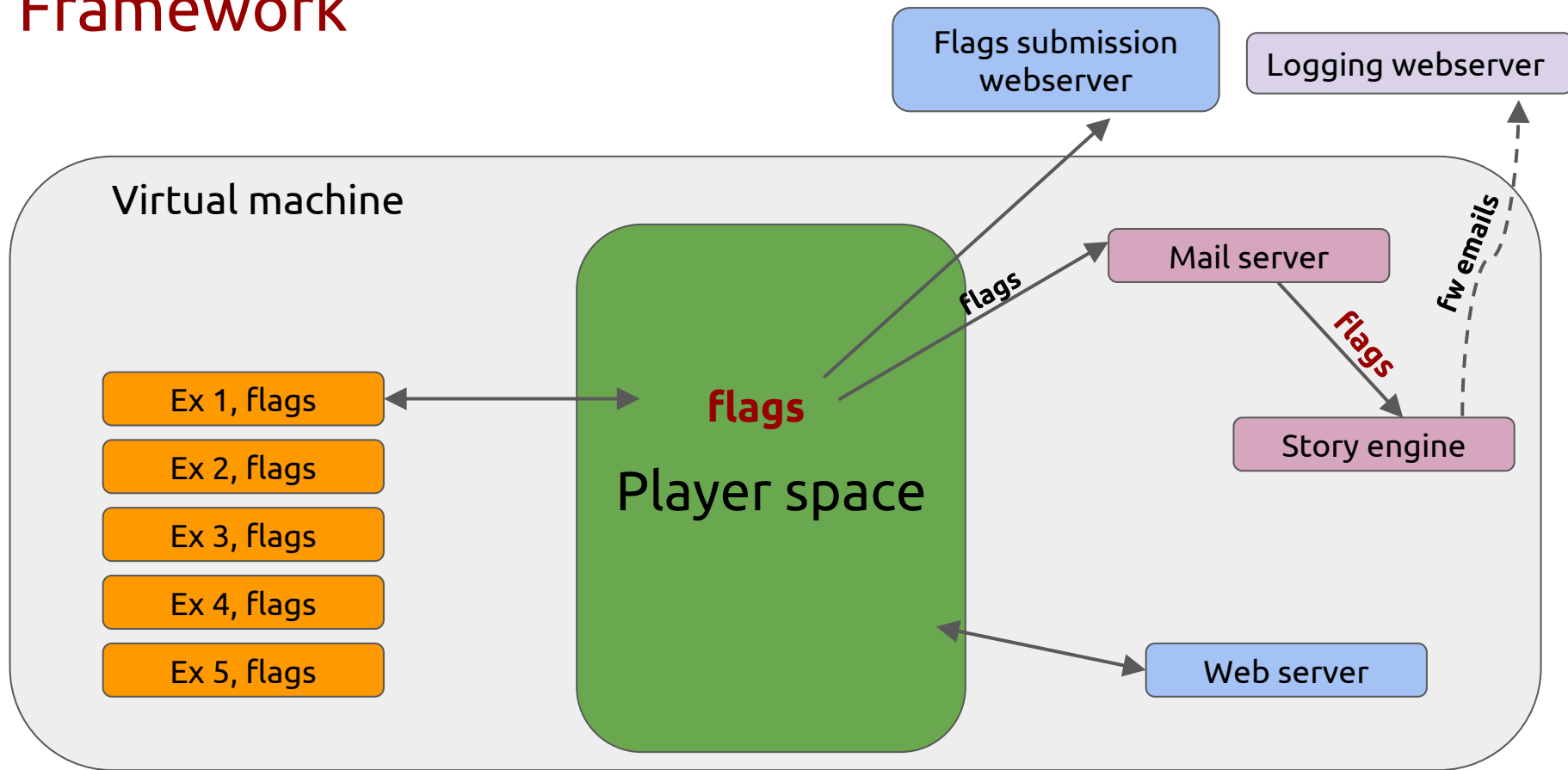
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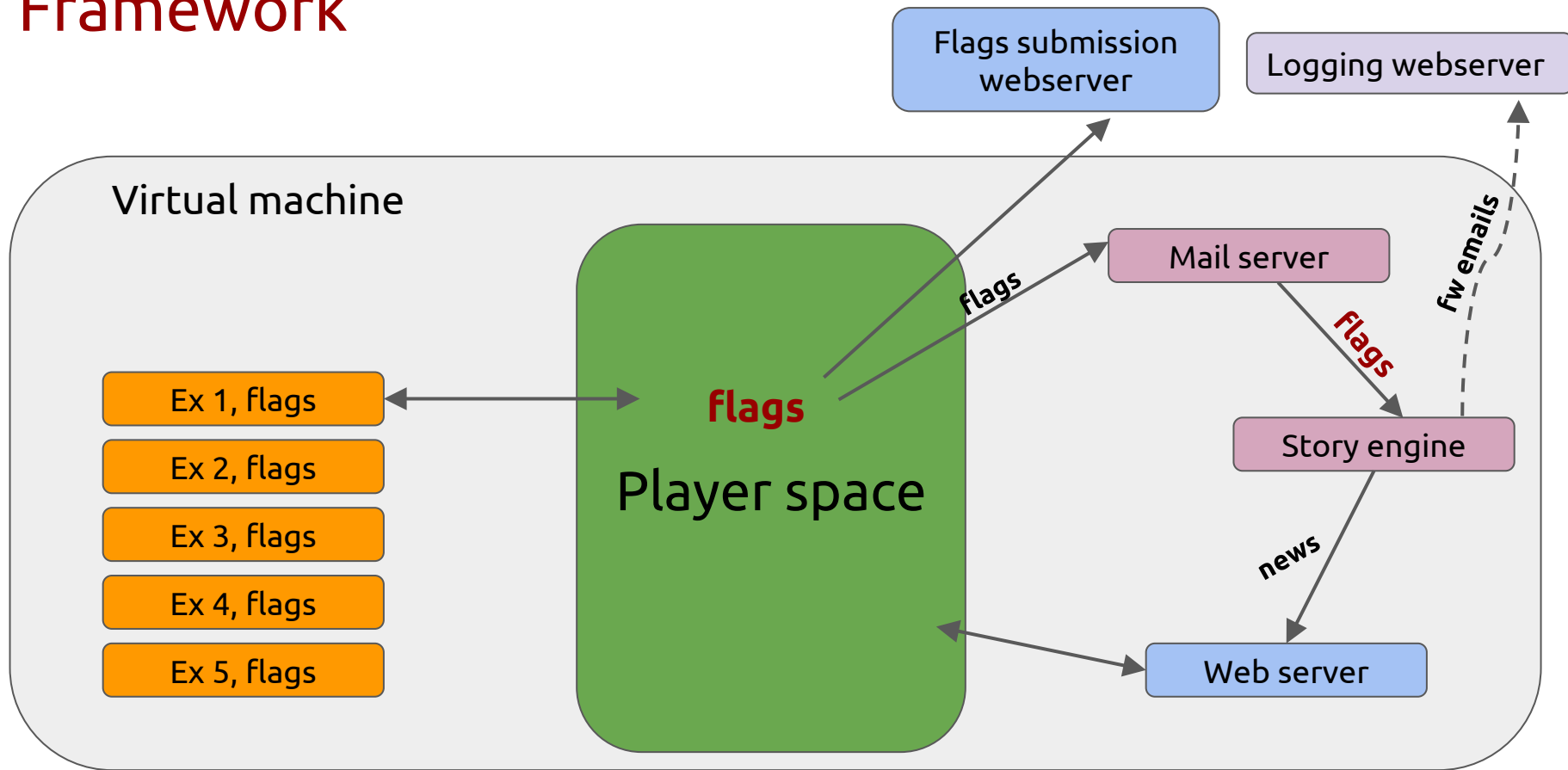
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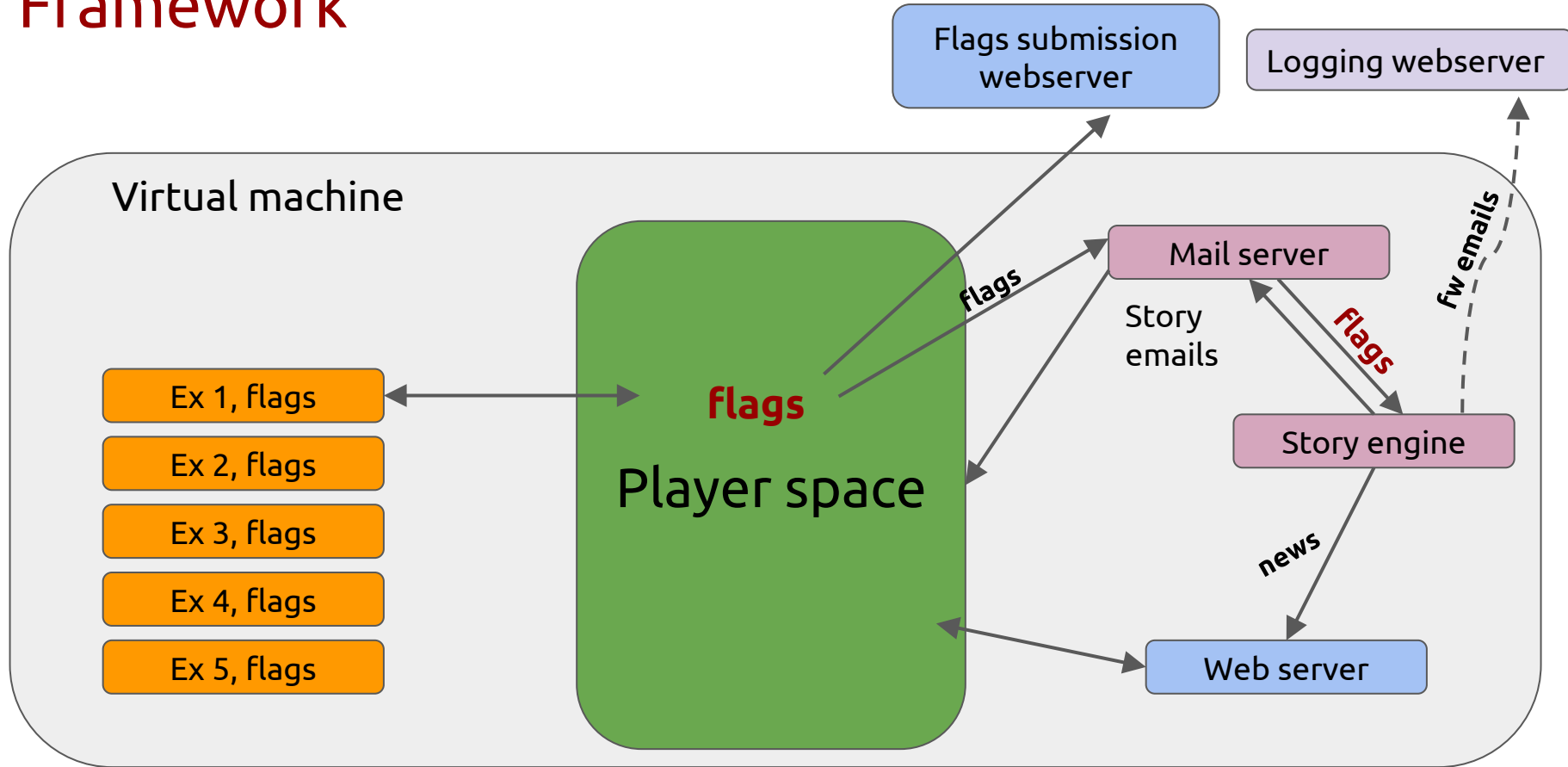
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Framework

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Story Engine

Written in Java -- but simple to use/change

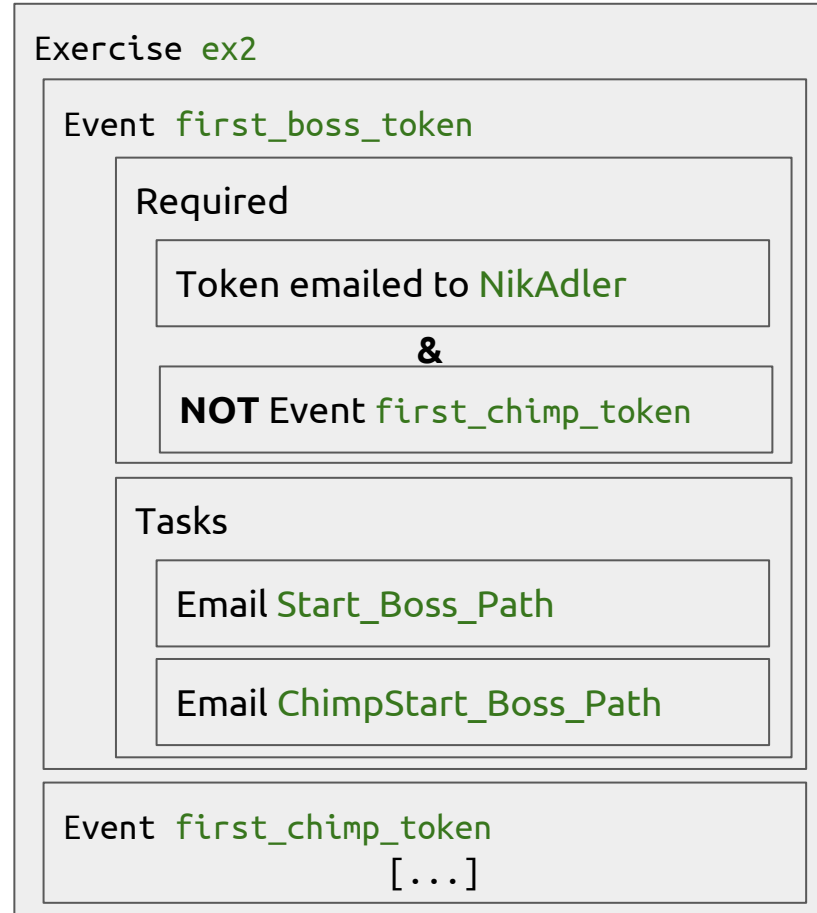
-> reads an XML config file which contains the story logic

-> same file keeps track of story progress

-> interaction via emails, the **flags (tokens)** being keywords

-> email templates and news stories stored on VM

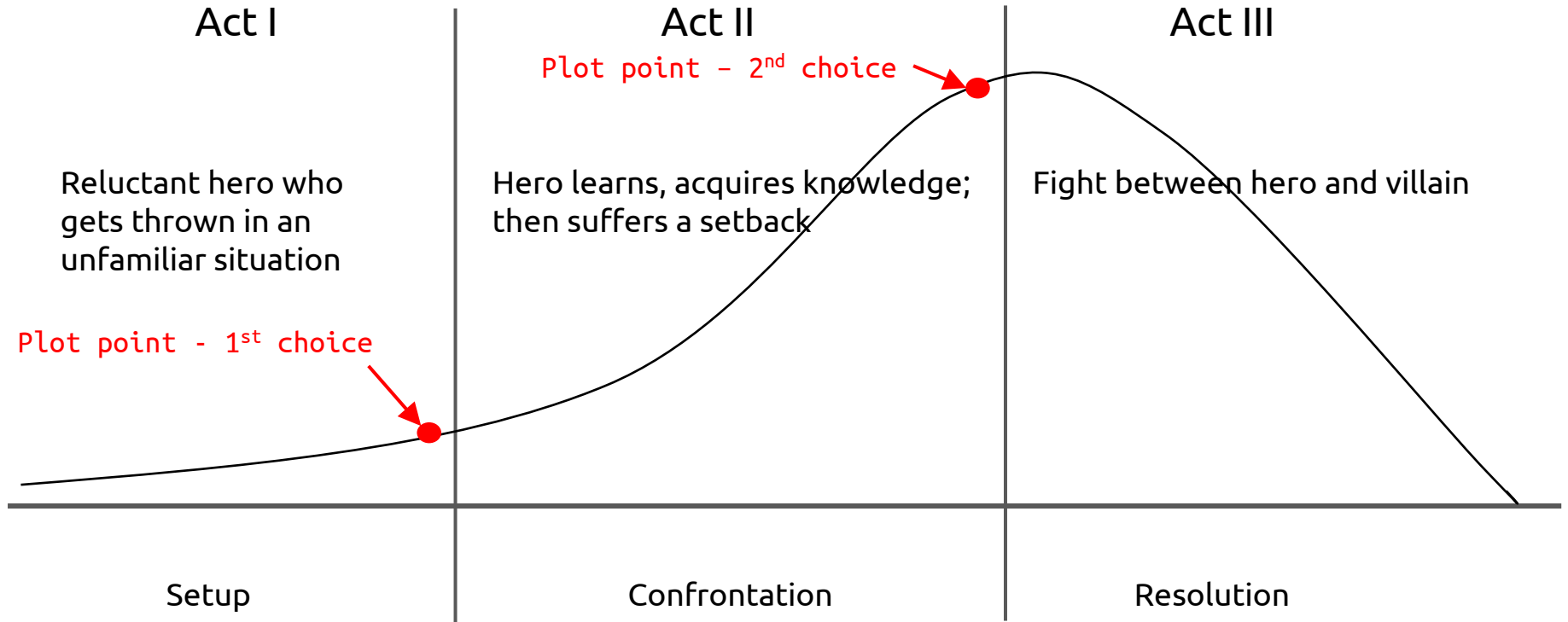
Experimental: logging choices sent by students



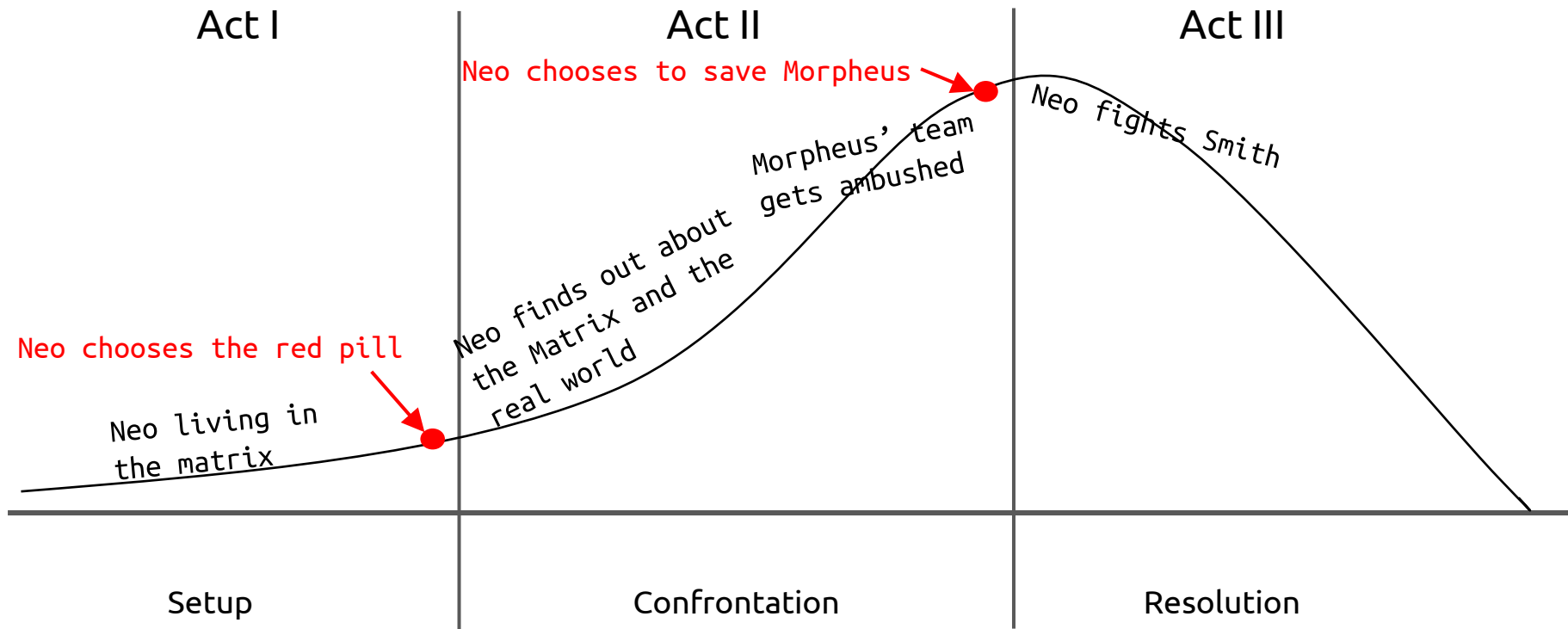
Story XML High-Level Definition

Story time!

Three-act structure



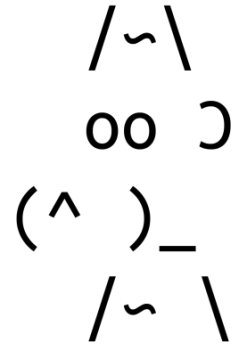
Three-act structure in THE MATRIX



Characters



Employee 427



Chimp
(Charle Garcia)

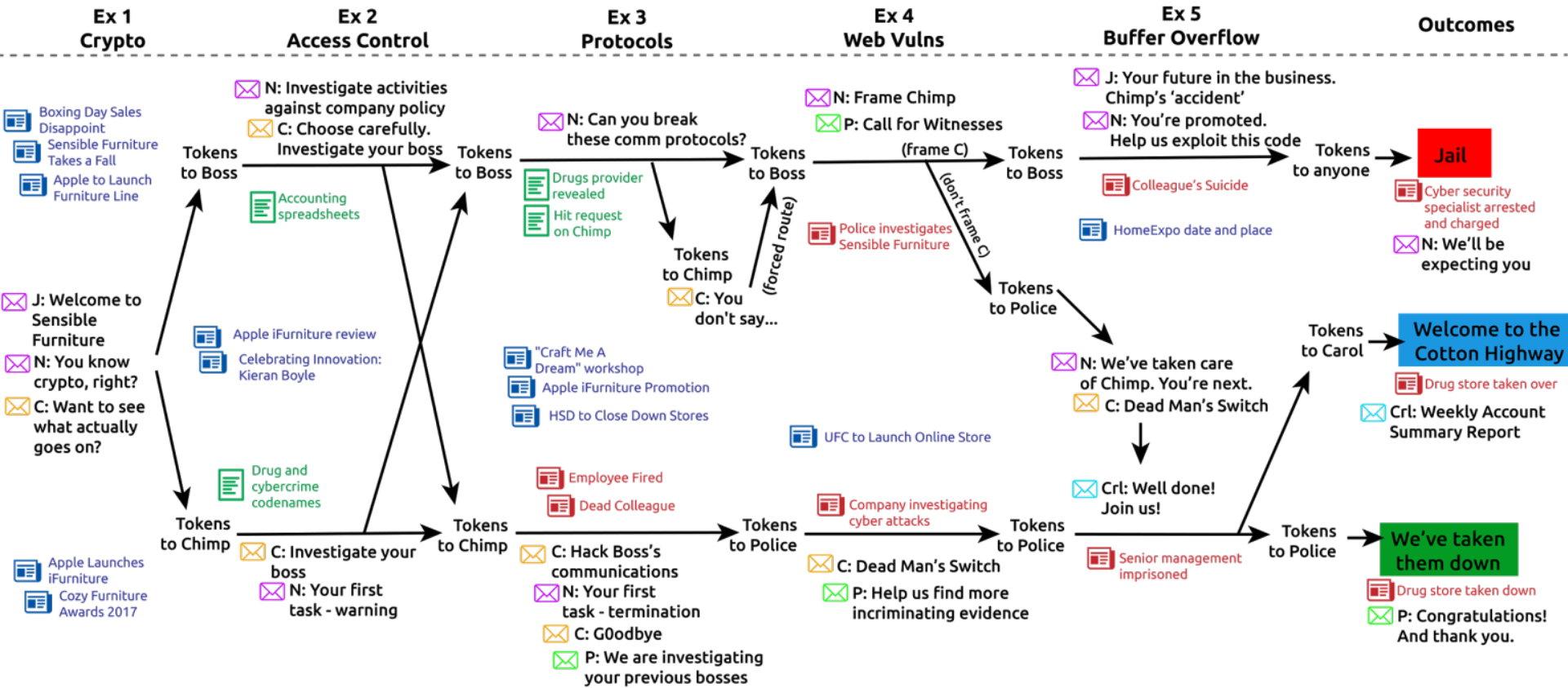
The Bosses



Jak & Nik



Carol
IT admin

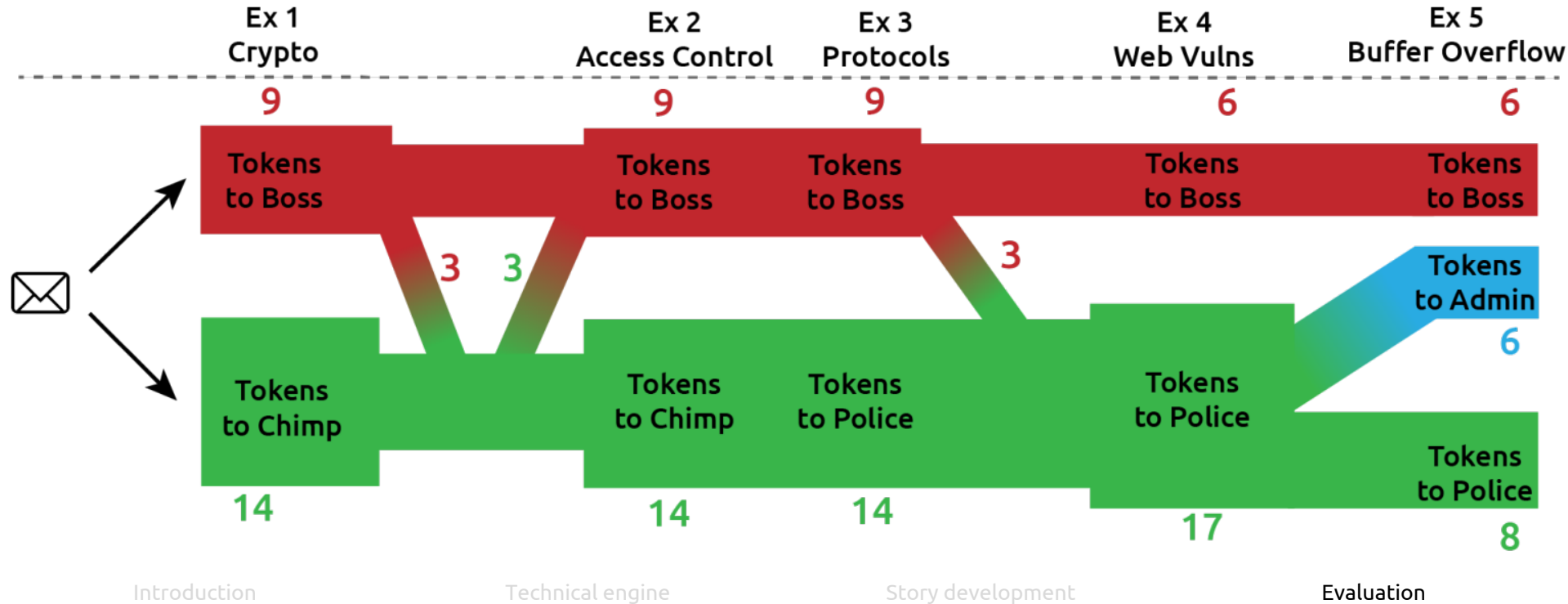


Legend: Static story Dynamic story Email from bosses (Jak or Nik) Email from Chimp Email from Police Email from the admin (Carol) Forensic evidence

Results & Evaluation

Results - Student Choices

23 students began the story; 20 saw it through to the end



Evaluation

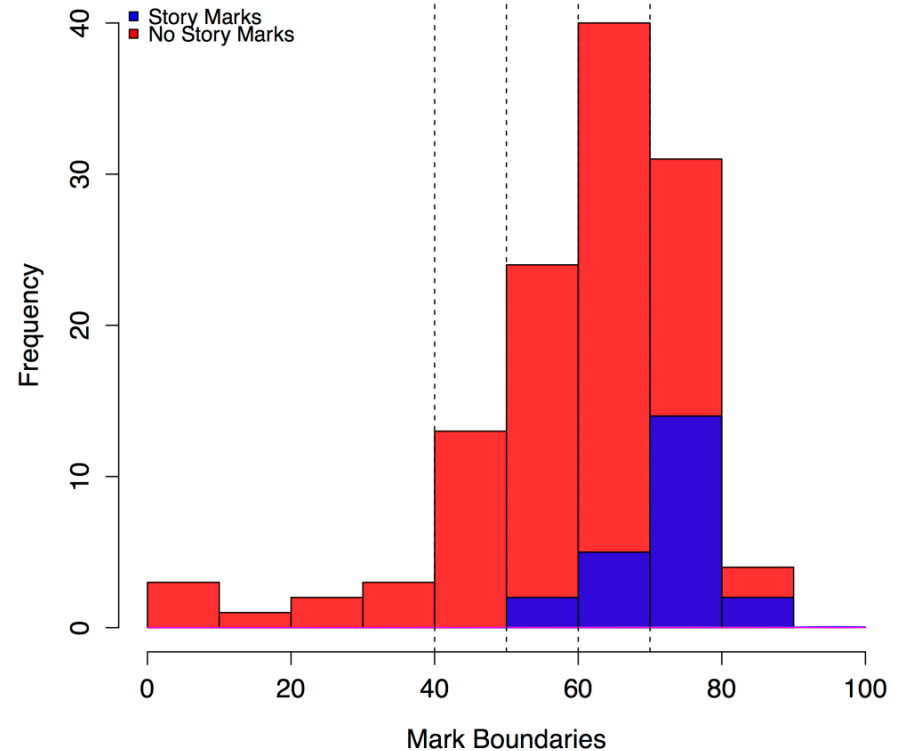
23 out of 144 students started the story

Self-selected sample - following the story was voluntary

Students following the story avg **11.08** points higher than no story

Student engagement - reading week reports contained **74%** more words for students who followed the story

2016–17 Academic Year Results



Evaluation

Comparison with prev academic year:

	ICS CA vs 15/16	ICS CM vs 15/16	ICS CM Avg	15/16 Avg
No story	+5%	-10.6%	63%	72%
Story	+18%	-5.1%	72%	77%

Accounting for individual capability:

$$\Delta = 15/16 \text{ mark} - \text{ICS mark}$$

	Avg Δ
No story	-9.22
Story	-5.09

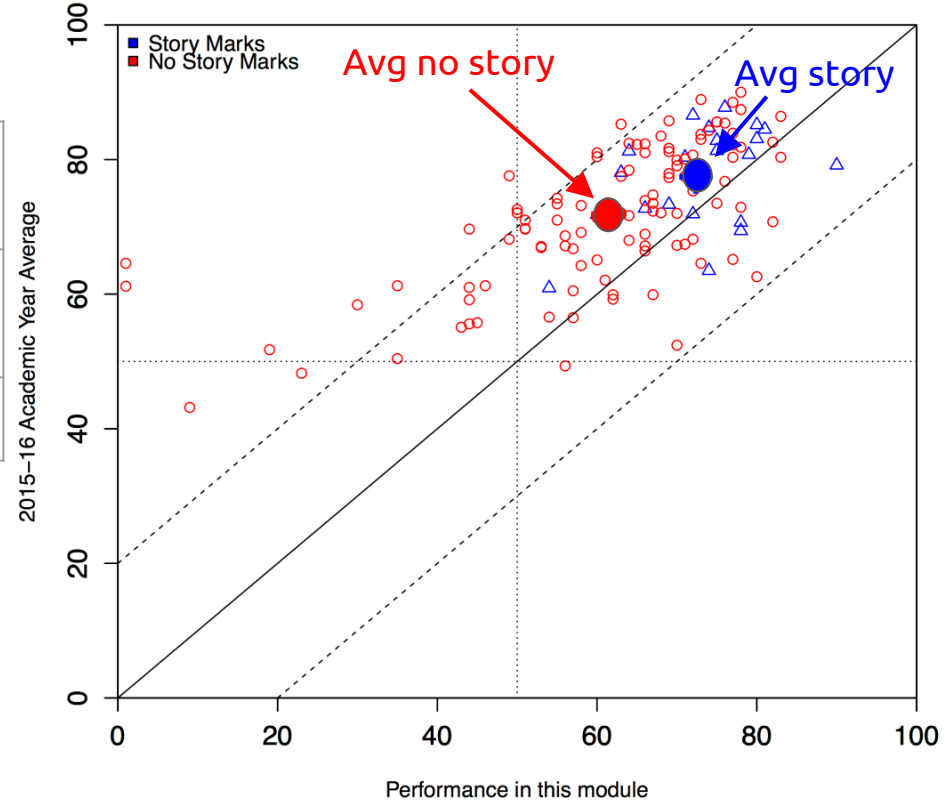
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Evaluation

Scatterplot of Student Marks



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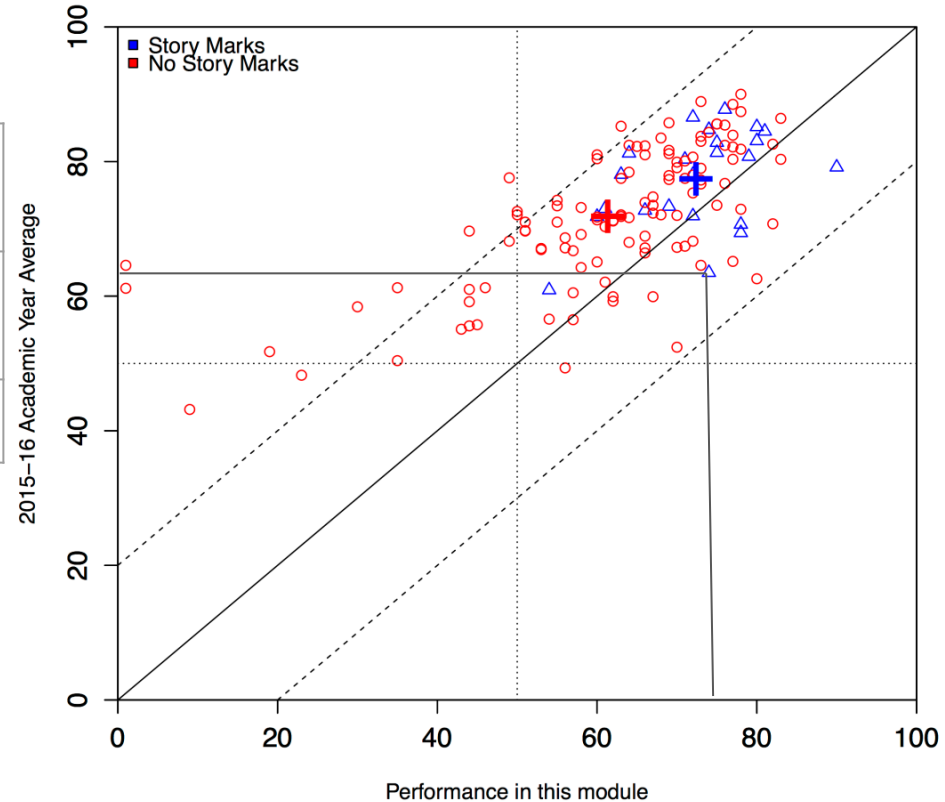
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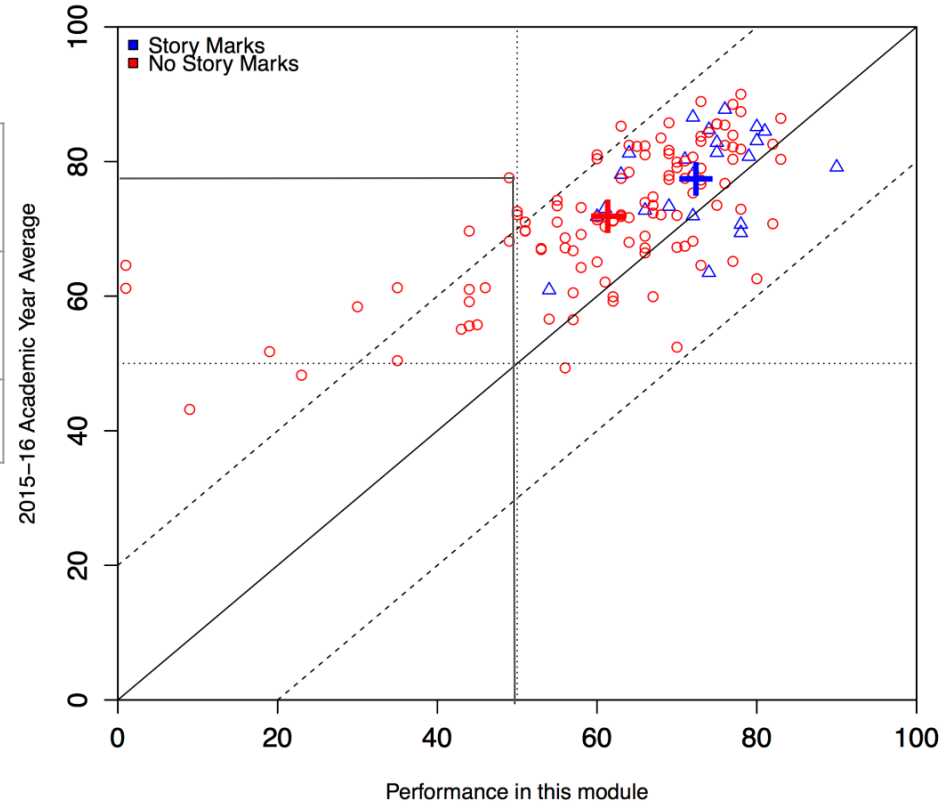
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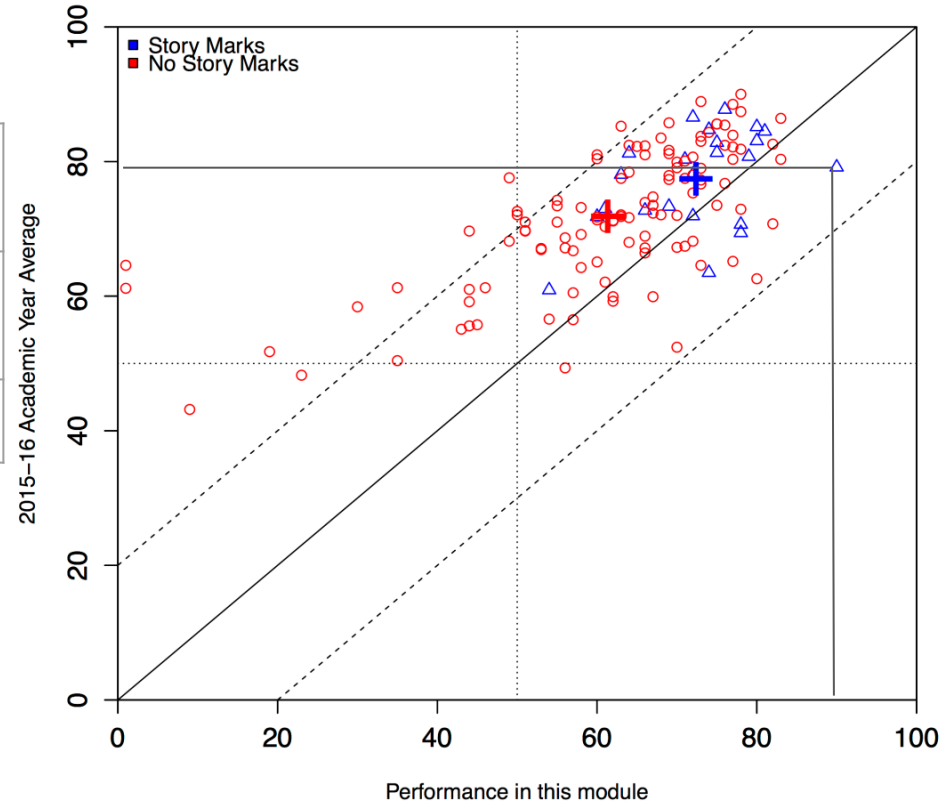
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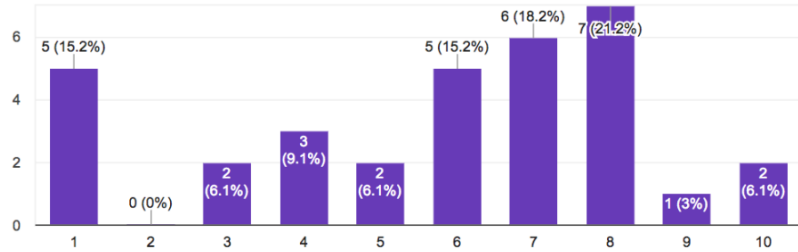
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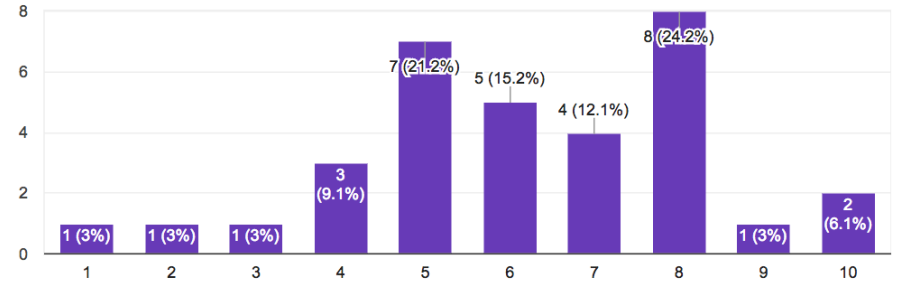


Evaluation - Survey

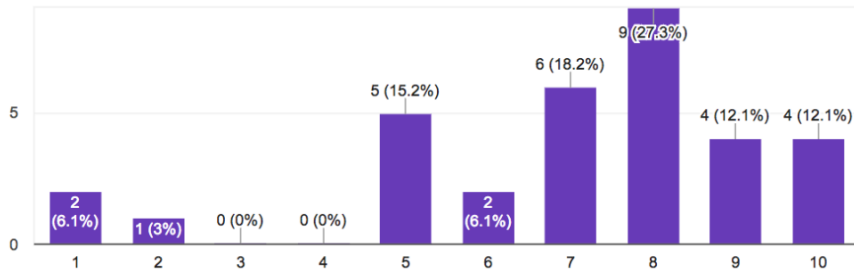
Did the story increase your level of engagement with the module? **Avg 5.5/10**



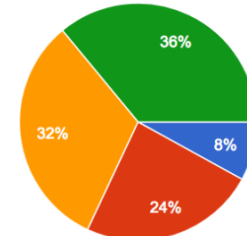
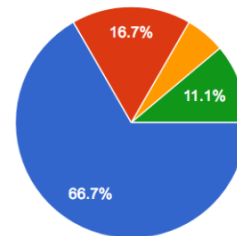
How interactive did you find the story? **Avg 6.18/10**



Please rate how fun you found the story **Avg 7/10**



Time spent on the story vs time perceived to be needed to finish story



- 1 hour
- 2 hours
- 3 hours
- More than 3 hours

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Student comments

Comments on story or plot

- I did like the complicated underground manoeuvres of the Sensible Furniture crowd. The Charles Garcia reveal and discovering the message that led to his demise was also a big moment in the tale.
- Was genuinely upset when Chimp died. RIP.

Were you happy with the ending?

- No. Because I went to jail. Also I can see now that there was a way to win as the bad guy.
- I liked the opportunity to choose a path, but also be able to change at certain points. Felt involved with the characters and had a fitting ending.
- I didn't lose (end up in jail), the taste of victory is sweet.

Why do you think that concept of adding the story is a good idea?

- Engages students to pay attention to the exercises, gives them a little real-life context (which often aids understanding) and instils confidence in students that the course is being very well-managed.
- It's a lot more engaging and it puts you in a hackers position (something we've all wanted to do) without the real life consequences.

Would other courses benefit from a story mechanic?

- I could see something like this working for robot programming where you would have to program a virtual robot in some sort of story.
- Modules like Graphics can have story elements. So for example, a detective case: to get the final clue to solve the murder/treasure, one needs to create this graphical image which contains some clue.

Future work

Use the framework emails as formal flags submission.

-> require students to take part

Working with other Universities which are interested in adopting and expanding the framework

Adding story engine into SecGen framework (Cliffe Schreuders, Leeds Beckett University).

Conclusion

Developed a choose-your-own-adventure **story engine** which can be added to exercises, in order to tie them together in a real-life scenario

Wrote a story for our ICS module, based on investigating a black market site

Showed that adding a story increased student engagement with the course material

Showed that students who followed the story did in fact score higher marks in ICS

Exercise sheets, VM & co:
<http://www.cs.bham.ac.uk/internal/courses/comp-sec/story>

Questions time!

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