Little Man Computer educational game

A game that teaches students how the Von Neuman architecture and assembly code works.

By: James Haddad
Email: jh1662@canterbury.ac.uk

Supervisor: Tina Eager

Canterbury Christ Church University

Problem:

Education is a vital necessity for one's path in the future; however, most people only do the bare minimum to pass each education stage (Sharpes, 2014; Mauliya et al., 2020). Not only does this risk failing higher education but also discourages people from entering advanced education (Mauliya et al., 2020) beyond what is legally required or beyond living a good enough life. The problem for the individual is multiplied for the collective of society - causing academic stagnation (Sharpes, 2014).

Proposal:

The proposed product is an educational game, of a CPU simulator, in LMC standard. It is suited for the age range of teenagers (13-18) as the main audience but will also be used by younger people and teachers. It will be a major improvement over the existing LMC simulators.

For making student learning of the processor more enjoyable.

For helping underqualified teachers.

For promoting learning by following the learning theories.

priorities:

	Offline (2nd)	Online (1st)
In class (1st)	Progressive Web App for Desktop (landscape)	Desktop webpage (landscape) - default
On the go (2nd)	Progressive Web App for mobile (portrait)	Mobile webpage (portrait)

Timeline:

(simplified from GANTT chart)

January	Literature review and requirements analysis.
February	1st and 2nd Sprints.
March	3rd Sprint with volunteers testing.
April	Porting to multiple app types and finish the dissertation.
May	Spare time for inconsistencies.

Image from shutterstock: https://tinyurl.com/39my9xru

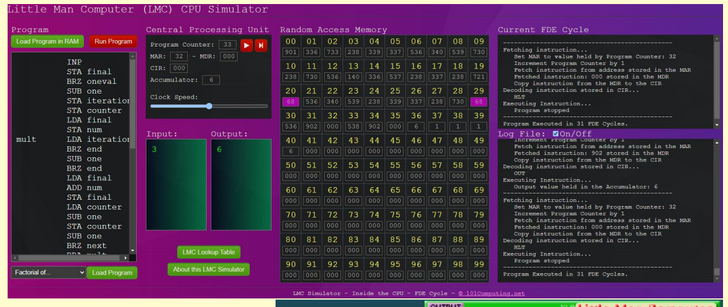
Agile Development

1	2	3
LMC processor	Compiler and basic UI	Game mechanics and levels with better UI

UK Secondary schools: (2023/24)

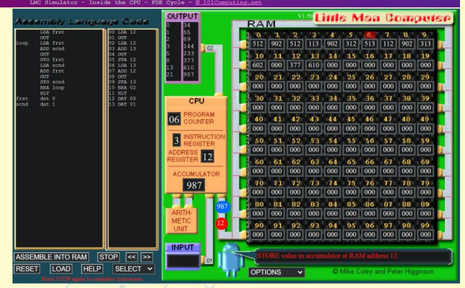
Data from gov.uk – https://tinyurl.com/2kw6nb7y

	Hours taught	Specialised teachers
Computer Science	66,216 (1.8%)	7,852 (3.4%)
Total	3,768,681	232,765



Other LMC screenshots:

The screenshot above is from https://www.101computing.net/LMC while the one to the right is from https://peterhigginson.co.uk/lmc/



Education by learning theories:

(Muhajirah, 2020)

Behaviorism	Cognitivism
Humanism	Constructivism

More theories:

- Multiple Intelligences Theory
- Situated Learning Theory
- Mindset Theory

LMC simulated architecture:

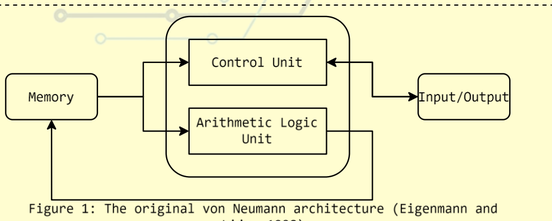


Figure 1: The original von Neumann architecture (Eigenmann and Lija, 1998)

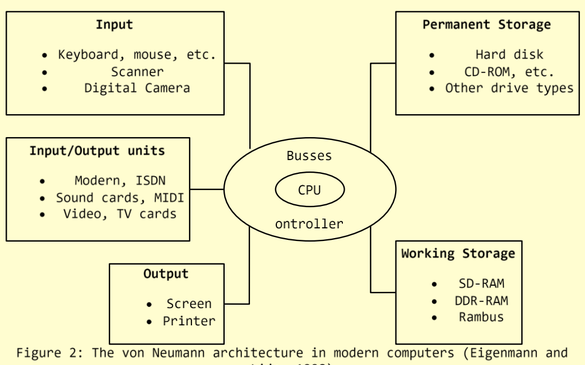


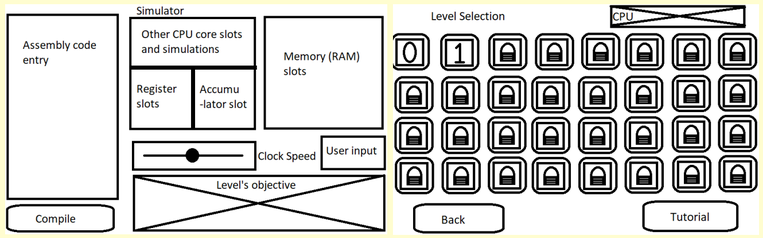
Figure 2: The von Neumann architecture in modern computers (Eigenmann and Lija, 1998)

Eigenmann and Lija (1998) comparing the original 1945 von Neumann architecture to it in modern computers. Diagrams copied and supported by Arikpo et al. (2007).

Comparing language candidates:

	JavaScript	TypeScript	Kotlin
Compatibility	Natively understood and interpreted by browsers	Compiles to JS	Compiles to JS
Handling variables	Dynamic typing	Static typing	Static typing
Strictness	Loosely typed	Strongly typed	Strongly typed
Support	Massive community and lots of libraries and guides	TS is a superset of JS	Interoperability with JavaScript
Debugging capability	Adequate debugging capability	Strong debugging capability	Strong debugging capability
Learning curve and difficulty	Best for beginners (easy) but complex for advanced features	Similar to JS with type safety and error checking but has more features to learn	Also have more features but different to JS, more towards android app development

Frameworks:



References:

- Arikpo, I.I., Ogban, F.U. and Eteng, I.E. (2007). Von Neumann architecture and modern computers. Global Journal of Mathematical Sciences. [online] doi:https://doi.org/10.4314/gjmas.v6i2.21415.
- Eigenmann, R. and Lilja, D.J. (1998). Von Neumann Computers. Wiley Encyclopedia of Electrical and Electronics Engineering. [online] https://public.callutheran.edu/~reinhart/CSC521/Week3/VonNeumann.pdf.
- Muhajirah, M. (2020). Basic of Learning Theory: (Behaviorism, Cognitivism, Constructivism, and Humanism). International Journal of Asian Education). [online] https://doi.org/10.46966/ijae.v1i1.23.
- Sharpes, D. K. (2014). A Long-Term Analysis of Social Networks of Students From a University Program for Seniors. ScienceDirect. [online] doi:https://doi.org/10.1016/j.sbspro.2015.04.642.
- Mauliya, I., Relianisa, R., & Rokhyati, U. (2020). Lack of motivation factors creating poor academic performance in the context of graduate English department students. Linguists. [online] https://pdfs.semanticscholar.org/f94e/d6362c07ea4b88c5cbe3cb8b56ef1724d509.pdf.