THE UNIVERSITY
of ADELAIDE

SCHOOL OF COMPUTER SCIENCE

CS Unplugged in SACE IT

Resource Guide for Teachers

Prepared by:
Dr. Cruz IZU, Dr. David HEMER and Dr Adam GHANDAR

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1 Introduction

This guide provides links to resources that can be used in SACE Information Technology classes. The main source of resources used in this guide is the CS Unplugged website (`http://csunplugged.org/`), which contains a number of activities for teaching Computer Science. These activities aim to engage students in an interactive manner, without the use of computers. Most of the activities are aimed at primary and middle school year students, however most also include extension activities meaning that they can also be used with senior students. The activities on the CS Unplugged website also contain links to other related activities, which can often be used as extension activities.

1.1 Relevance to SACE curriculum

The activities and resources listed in this guide are best suited to Topic 1: Computer Systems, of the Stage 1 Information Technology curriculum. However many of the activities could be applied in earlier years, or with extension could be applied to Topic 2 of the Stage 2 Information Technology curriculum.

1.2 Overview of resources

- CS Unplugged `http://csunplugged.org/binary-numbers`

- Computer Science and Engineering for K-12 `http://cse4k12.org/`

- CS Inside `http://csi.dcs.gla.ac.uk/`

2 Resources

2.1 Data representation

- A binary digit represents two states.

- A byte that is a pattern of 8 bits represents a character.

- A character can be allocated a unique code according to a scheme (e.g. ASCII code, Unicode).

- Data can be measured in bytes, kilobytes, megabytes, gigabytes, and so on.

2.1.1 Binary numbers

The Binary numbers activity on CS Unplugged (`http://csunplugged.org/binary-numbers`) is a simple activity that teaches students to count using binary numbers. Students *should* find this straightforward, however given that many students studying CS at university still struggle with binary numbers it is important that the teacher is satisfied that students have grasped the ideas before moving on.

To ensure that they are familiar with binary numbers, the teacher could use the following activities from the Computer Science and Engineering for K-12 website (`http://cse4k12.org/`).

- Counting in binary

- Converting from decimal to binary

- Converting from binary to decimal

As an extension students could use the binary number cards to perform some simple binary arithmetic (addition and subtraction).

Other activities

- Secret messages coded in a Music video, students need to use binary numbers to decode the real message of the song; `http://www.youtube.com/watch?v=L-v4Awj_p7g`

- Magic card trick using binary numbers: `http://www.cs4fn.org/mathemagic/carryonconjuring.php`

2.1.2 Hexadecimal

Three activities relating to Hexadecimal numbers are available on the Computer Science and Engineering for K-12 website (`http://cse4k12.org/`).

1. Counting in Hexadecimal

2. Converting from binary to hexadecimal

3. Crossbin puzzles (Binary, Hexadecimal)

The first two activities could be used for students to gain familiarity with hexadecimal representation, while the third activity could be used for practice and to test their understanding.

As an extension students could be asked to research where hexadecimal numbers may be found.

Other activities   Khan Academy Instructional Movies (introductory materials):

- `http://www.khanacademy.org/video/binary-numbers?playlist=Pre-algebra`

- `http://www.khanacademy.org/video/binary--decimal-and-hexadecimal-number-systems?playlist=Pre-algebra`

Mental arithmetic, fast calculation by dividing numbers by 5 `http://www.cs4fn.org/mathemagic/fastfives.php`

2.1.3   Data encoding

Using binary to encode text

Ascii - Binary weaving `http://www.raft.net/readpdf?isid=303`

Braille Combinations `http://www.cimt.plymouth.ac.uk/resources/codes/braille-codes/default.htm`

2.1.4   Text compression

`http://csunplugged.org/text-compression`

Extension from CS inside Zipping it up (Note: this extension from CS inside seems to me to have a big overlap with the cs unplugged activity).

Extensions   CS4FN – magic of mp3 (`http://www.cs4fn.org/mathemagic/sonic.html`)

[Introductory video from YouTube] Computer Science Buskers? (Error Detection) : `http://www.youtube.com/watch?v=OXz64qCjZ6k&list=UUI3-5XVIw7-JI1a4VhuMZzw&index=10&feature=plcp`

Web game, fixing pipe network `http://www.cs4fn.org/algorithms/maxflow/`

2.1.5   Image compression

`http://csunplugged.org/image-representation`

Extension from CS inside

- Painting by numbers

- In the picture

2.2   How computers work

During a process, such as comparing two numbers, parts of a computer perform specific functions with data; the parts include the central processing unit (CPU), the arithmetic and logic unit (ALU), random-access memory (RAM), read only memory (ROM), and registers.

The Computer Science and Engineering for K-12 website (`http://cse4k12.org/`) includes the "How Computers Work" exercise, which provides a simulation of three major components (CPU, ALU and Display) of a computer. Whilst the activity is designed for primary and middle school students, it should provide a good introduction or refresher to SACE level students. This activity could be used as a lesson introduction, with only a short introduction required.

To extend this activity the teacher could get the students to use on of the freely available CARDIAC emulators (e.g. `http://www.kaleberg.com/software/cardiac/index.html`). Cardiac (Cardboard Illustrative Aid to Computation) was originally a cardboard model of a computer, used in the classroom. The teacher demonstrate the use of the CARDIAC simulator, then get the students to develop a simple program using the emulator

2.3 Networks

How is data transmitted between computers?

- A collection of computers and devices connected together via communication devices and media forms a network.

- Communication devices include network cards, modems, switches, routers, and hubs.

- Communication can be over physical or wireless transmission media.

- A protocol is a set of rules for exchanging data between computers.

- A server manages a set of resources on a network.

- A network can be classified as a local area network (LAN) or a wide area network (WAN).

2.3.1 Routing and deadlock

`http://csunplugged.org/routing-and-deadlock`

2.3.2 Network graph topology

`http://csunplugged.org/minimal-spanning-trees`

2.3.3 Error detection

`http://csunplugged.org/error-detection`
Extensions

- CS Inside - Tablets of Stone - ask students to devise their own protocols and see if they worked.

- `http://people.cs.ubc.ca/~kla/index.php?page=Network_Routing_on_Strings`

  This extension is quite open, start with a small network and simple topology and make it bigger later on.

2.3.4 Encryption

`http://csunplugged.org/public-key-encryption`
Extensions

- `http://sites.google.com/site/childrenandtechnology/Home/presentation-6-privacy-and-enc`
  this is simple but gets them thinking about the different ways to deal with privacy

- `http://www.rigb.org/christmaslectures08/html/activities/keeping-secrets-secret.`
  `pdf` this document provides two examples of encryption: visual cryptography and clock
  arithmetic.