Australia-ASEAN Academics Forum

Online education during Covid-19 and beyond.
**OUTLINE**

- Online Education
  - Practical Education with Laboratories
  - Remote Laboratories

- Computational Intelligence
  - What it is ...
  - How can it help in online education
Practical Knowledge
ENGINEERING EDUCATION

- Education related to engineering fields.
  - Involves learning a concept, strongly supported by mathematical models
  - Verifying the concepts through real-world examples
  - Service-learning

- Engineering Education includes various fields – general physics, chemical, mechanical, computer, electrical, architectural etc.

- Practical knowledge of engineering and its context is essential
Role of Laboratories in Practical Education

- Practical Education is a must in Engineering and Science
  - Revising the conceptual knowledge
  - Validating the knowledge with practical setups
  - Hands on Experience - how to do things
    - Safety
    - Efficiency
  - Collaboration and group work
WHAT DOES IT INCLUDE?

- An apparatus – the main hardware setup
  - Can be a rigid body big electronic devices
  - Can be a flexible body setup
  - Reconfigurable with software/electronically or mechanically

- Consumables
WHAT DOES IT INCLUDE?

- ICT or computation only labs
  - Typically, when high end computing resources are needed
  - Networking or AI
- Remote Desktop access
- UTAS Labshare was created to give ICT students access to the PC and Mac Labs for teaching purposes.
Remote laboratories are the online version of the practical experimental setup.

The setup is connected to internet.

Lets students access the learning materials and equipment anytime and anywhere.

First appeared in early 2000s
- Main need was to manage resources and give students more access
- The online interface was basic
- In early days, it was mainly about electronics experiments
EXAMPLES

- iLabs (US, Australia and various places)
- WebLab (Europe)
- REXlab (Brazil)
- Golabz
- iSES
ONLINE LABORATORIES

- Key aspects of the remote laboratories:
  - Scheduling:
    - Manage student’s access
    - Different strategies: time slots, queueing
    - Student experience is different for each type
  - Web interface
    - Controls
    - Visual Feedback - Camera
WHAT WE DID IN UTAS

- Teaching of electronics and computer systems units
  - Since 2017 we had some form of remote laboratories for teaching embedded systems
  - Since 2020, this has been expanded to internet of things and web application units.
INTERFACES

Actual Devices

Web Interface

Automation
ONLINE LABORATORIES

- Key aspects of the remote laboratories:
  - Everything can be logged, unlike a classroom lab
    - Commands
    - Programs
    - Configuration Setup
PROBLEMS WITH REMOTE/ONLINE LABS

- Lack of hands-on experience
  - Virtual reality – needs ubiquitous devices

- Lack of collaboration
  - Shared web interface – network is an issue
INTELLIGENT COMPUTING IN EDUCATION

- Adaptive to student needs
- Figure out the problems – common hurdles
- 24x7 availability of support – improved version of google
INTELLIGENT COMPUTING IN EDUCATION

- Automation
  - Let the students submit ‘anything’
  - Evaluate automatically

- Example:
  - Text mining –
    - Plagiarism
    - Marking
Grammarly allows the user to tweak a lot of parameters. The software then measures the quality of the documents.
**APPLICATION OF AI**

- Pattern Recognition
  - Train on data to create models
  - Match new information with the model

New Image

Training Images

Model (Neural Network)

It is a cat

The picture can't be displayed.
Every input is recorded digitally - commands, programs, and configuration setup

Real-Time data collection and storage

The inputs for AI can be any of these

The outputs are:

1. The absolute quality of the input for any given task.
2. Progress of the student with respect to time and peers.
3. Feedback generation on the input based on its type.
1 ABSOLUTE QUALITY ASSESSMENT

- This is basically similar to marking an exam.
- We grade whatever the students upload or do on the web interface

1. Input for AI:
   - Student inputs to the experiments
   - Collected over a few semester
   - The learning activities must be the same each time

2. AI Model:
   - Contains all possible classifications of student inputs
1 Absolute Quality Assessment

3. Output from AI:
   - A quality rating – How correct the inputs are given a specific experimental activity?

New Program

Model (Neural Network)

It is a good program

Training Programs

18/6/21
2 PROGRESS OF STUDENT

- Critical aspect of the student is to be able to complete tasks in time
  
  - Learning goals - stages within each learning activities
  
  - Every task and subtasks ‘should’ to be done in a time limit
  
  - Live tracking of the student progress
    - Check if someone is falling behind
    - Check if student are not doing the right things
3 FEEDBACK GENERATION

- What to tell the student?
  - *Direct Feedback*:
    - Given the answer directly
  - *Indirect Feedback*:
    - Point out what should not be there in the inputs
    - Provide hint on what should be there

- Where to stop?
  - Ex. Grammarly has no end
  - But online learning cannot give all the answers
3 FEEDBACK GENERATION

- Real-time vs on-demand feedback
  - Should we provide feedback automatically – the system can monitor the students in real time.
  - Should the feedback be given only when student wants it.

- Depends on activities and the desired speed of the student
INSTRUCTIONAL DESIGN FOR REMOTE LABS

- Modular

- Single user focused
  - Scheduling two users at the same time is difficult.
  - Group based activities are difficult.

- Activities typically take 10-15% more time for the students
  - Due to web interface
  - Client devices

- Video based tutorials – not just text and images
CONCLUSIONS

- Remote labs has been used for simple access and control
- Augmented Learning experiences
- Can be supported with multiple AI tools for individual training
QUESTIONS?