APPLICATION DEVELOPMENT

WEB DEVELOPER JR

"I want to build awesome websites!"

Level 1	Build a static website.
Level 2	Build a website. Enhance the layout of the web elements with CSS.
Level 3	Build a website with interactive elements on the page using Javascript.
Level 4	Build a web application with dynamic elements that pull information from an information source. *Information sources such as databases, web services, or online open data can be used.*
Level 5	Build a web application that stores and retrieves data from an external database in the server.

MOBILE APP DEVELOPER JR

"The future is mobile."

Level 1	Describe a problem you are facing that can be solved by using a mobile app.

Describe a problem you are facing that can be solved by using a mobile app.
Research on existing apps which can solve the problem, and highlight pros and cons of each app.
Conceptualize your own app to solve the problem through:
- sketching out each screen that the user will interact with.
- creating a storyboard that clearly shows the navigation flow between the different screens.

Students can browse existing App stores to find apps that best solve the highlighted problem. Conceptualization can be done using online tools.

Level 2

Examine a website that has a lot of information and contents.
Conceptualise your own app to present the information in a mobile-friendly manner.
Design a prototype of the app which will run via emulators.

Students can look at their school website as an example. Building of app can be done using drag and drop tools with ready templates that allow customizations.
Good, but not critical here to get students to code and build the app from scratch. Students are not expected to deploy the app onto an actual device.

Level 3

Build an interactive app that will benefit a community of people.
Deploy a prototype of the app onto an actual device.
Obtain some feedback from users of your app.

The student should identify a hobby/interest of his/her own, and explore ideas that can benefit people of this community. Building of app can be done using drag and drop tools with ready templates that allows customizations. Students are not expected to code and build the app from scratch.

Level 4

Build a mobile app that requires user inputs, performs some computation, and presents meaningful information.
Enhance the mobile app with features that help the user interpret the information better.
Deploy a prototype of the app onto an actual device.
Obtain some feedback from users of your app.

Students are expected to do some coding here. Examples of features that help the user interpret the information better could be filters, search fields, Infographics. Examples of some possible apps would be BMI calculators, currency/temperature convertors.

Level 5

Build a mobile app that allows user to store and retrieve information into/from a database.
Deploy a prototype of the app onto an actual device for testing.
Deploy that mobile app onto an online store where public users can download.
Obtain at least 1 review from a user of your app via the online store.

Database can be stored locally or online. Students are expected to do a reasonable amount of coding here.

GAME DEVELOPER JR

"Don't just play games, build them!"

Level 1
Build a single player game.
Enhance the game with at least 2 playable levels.

Level 2
Build a multiplayer game for at least 2 players.
Enhance the game with persistent local storage on players' progression.

The expectation is for a local co-op, and students are not expected to create a network-enabled multiplayer game. Examples of stored information could be high score, save states.

Level 3
Build a game with dynamic contents.
Enhance the game with two levels of difficulties to cater to different skill levels of the players.

By dynamic contents, it means that every play session should feel different. Students can randomly generate some aspects of the game such as enemy positions, positions of power-up or have the game AI respond to the player's actions differently.

Level 4
Build a game and maintain a game document alongside the development.
Enhance the game with at least 3 levels of dynamic contents.
Conduct a player test session to obtain feedback.
Demonstrate an enhancement of the game based on at least 3 of the feedback points.

The expectation is for the student to create at least 3 distinct levels of game play. For each level, students can randomly generate some aspects of the game such as enemy positions, positions of power-up or have the game AI respond to the player's actions differently.

Level 5
Build a game that is playable online.
Enhance the game with online storage on players' progression.

An example would be a game hosted online with a persistent leader board for high scores.

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CYBER SECURITY

DIGITAL FORENSICS JR

"Nothing is deleted forever."

Level 1

Write a journal entry on:
- at least 3 different online risks that internet users face these days
- at least 3 different ways in you can protect yourself from potential risks online
- at least 1 case study of how sensitive information stored on mobile phones or laptops have been misused

Share with your friends if you have any similar personal experiences.

Level 2

Write a journal entry on at least 3 different ways in which software or policies help enforce cyber safety for the individuals.

Research on at least 3 good practices when handing over your computing device to the repair shop or loaning it to your friends.

Students can look at applications such as games that they use frequently and see how safety is enforced, e.g. the amount of time you can spend playing a game is controlled. Computing devices would include the students' laptops or mobile devices.

Level 3

Write an article on a personal story of how you (or a friend) have been affected by a security threat and share the article with your friends on a social network.

Research on the ways in which you are leaving traces of yourself unintentionally online.

Examine your own online profile, as well as those of your teachers and classmates and then do a sharing on the risks of the information shared.

An example could be how the student suffered a virus attack as the anti-virus software was not updated regularly. A fair amount of learning is expected on the following topics of malware, firewall, anti-virus software, OS system patches. Students can also research on how they are leaving traces of themselves online such as through geo-tagged photos.

Level 4

Research and write an article on ways you are leaving traces of your computer activity in your computing devices and share the article with your friends on a social network.

Research on existing tools/methodologies which can help protect your sensitive information from being recovered when your computing device is transferred to someone else or lost, and demonstrate it on an appropriate computing device.

Students are expected to learn deeper about how files are stored and structured by the Operating System, and how common computer activities leave behind traces (such as temporary files) unknowing to them.

Level 5

Research on an existing digital forensics tool which can carry out recovery operations on computing devices.

(Under controlled environments with advice from your teachers or trainers) Attempt to recover information from a re-formatted computer drive.

Students can research and select an existing free tool that is suitable for their platform. The teachers or trainers should prepare a re-formatted computer drive for such training purposes. Mobile devices can also be an alternative.

ETHICAL HACKER JR

"I find weaknesses in your system, so others won't."

Level 1

Write a journal entry on:
- at least 3 different online risks that internet users face these days
- at least 3 different ways in you can protect yourself from potential risks online
- at least 1 case study of identity theft

Share with your friends if you have any similar personal experiences.

> *An example of identity theft could be a compromise of a person's email or social media account which led to it being misused.*

Level 2

Write a journal entry on at least 3 different ways in which software or policies help enforce cyber safety for the individuals.
Research on at least 3 good practices when creating a password.
Reflect on your own choice of passwords and change the ones that are bad.

> *Students can look at applications such as games that they use frequently and see how safety is enforced, e.g. the amount of time you can spend playing a game is controlled.*

Level 3

Write an article on a personal story of how you (or a friend) have been affected by a security threat and share the article with your friends on a social network.
Research on the ways in which you are leaving traces of yourself unintentionally online.
Examine your own online profile, as well as those of your teachers and classmates and then do a sharing on the risks of the information shared.

> *An example could be how the student suffered a virus attack as the anti-virus software was not updated regularly. A fair amount of learning is expected on the following topics of malware, firewall, anti-virus software, OS system patches. Students can also research on how they are leaving traces of themselves online such as through geo-tagged photos.*

Level 4

Set up a simple network.
Demonstrate ways in which you can protect your network from unauthorised access.
Research on a simple encryption algorithm and practise encrypting and decrypting a message with a friend.

> *Students can set up their home Wifi network as an example.*
> *Students should conduct a research on modern encryption models that are commonly used. They are then expected to try out a simple encryption algorithm to get a sense of how encryption and decryption works.*

Level 5

Research on the different types of hackers – white-hat, black-hat, grey-hat.
Research on at least 1 case study of a high profile hacking incident.
(Under controlled environments with advice from your teachers or trainers) Attempt to penetrate a system and obtain sensitive information.

> *Students must learn about the legal aspects related to the act of hacking and where relevant, to sign a promise not to misuse their skills. Students should only attempt to penetrate a system with the supervision of the teachers or trainers. The teachers or trainers should set up a specific environment for such training purposes.*

DATA ANALYTICS

BUSINESS ANALYTICS JR

"From the sea of data, I see insights."

Level 1

Examine a finite set of data with at least 100 records.
Study the data and highlight some insights you got from this study.

Simple information such as sum, mean, median, standard deviations can be obtained. Investigation can be based on a fictitious set of data.

Level 2

Examine a finite set of data with at least 100 records.
Study the data and develop a simple dashboard comprising of at least 3 charts based on it.
Using the dashboard, make a presentation on some insights obtained from this study.

Simple information such as sum, mean, median, standard deviations can be obtained. Investigation can be based on a fictitious set of data.

Level 3

Examine a finite set of data with at least 5,000 records.
Study the data and develop a dashboard comprising of at least 5 charts based on it.
Using the dashboard, make a presentation on some insights obtained from this study.

Simple information such as sum, mean, median, standard deviations can be obtained.

Investigation should be based on real data collected. Students can look at the open data. (e.g. government data hosted on data.gov.sg, World data bank hosted on databank.worldbank.org)

Level 4

Examine data obtained from social media platforms or sites on the internet.
Devise ways to make sense of the data and obtain meaningful information from that set of data.
Build a website to present the information in a meaningful way.
Enhance the website with insights and predictions on future trends while supporting it with evidence based on the information you analysed from the data.

Data used here are unstructured in nature. Students should be introduced to sentiment analytics and learn about social media metrics. Students can use online tools or website generators to help build the website to present the information.

Emphasis here is on predicting future trends and supporting the arguments with evidence from the data.

Level 5

Crawl social media platforms or sites on the internet to obtain unstructured data.
Devise ways to make sense of the data and obtain meaningful information from the obtained data.
Develop a business opportunity that leverages on the analysis that has been made and make a presentation on it.

Students should be introduced to sentiment analytics and learn about social media metrics. Students are expected to obtain the unstructured data through their own means instead of being handed a set of data to analyse. They can use existing crawlers or other means to obtain the data. Emphasis here is on coming up with a business proposal based on predicted future trends that is supported by evidence from the data and/or additional knowledge of the context.
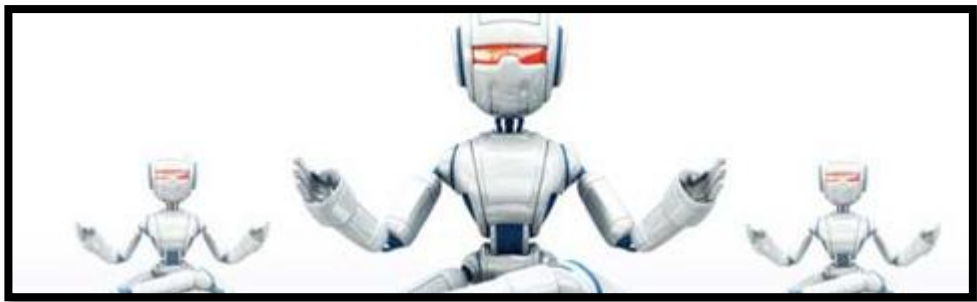
ROBOTICS & MAKER

ROBOTICIST JR

"More than meets the eye."

Level 1	Build a simple robot. Program the robot to obey 1 command from you.
Level 2	Enhance a robot that you built with at least 1 additional input/sensor. Program the robot to react to the information from the inputs/sensors.
Level 3	Program a robot that you built to perform at least one sequence of actions that accomplishes a task. Ensure that the accomplished task involves some form of movement from the robot with decision-making based on information from at least 1 sensor. *An example could be a dance routine.*
Level 4	Program a robot that you built to perform a sequence of actions that accomplishes a task which requires higher order decision-making capabilities. Ensure that the accomplished task should involve the use of information from at least 3 different types of sensors for analysis and to plan the robot's reactions/movements accordingly. *An example could be a search and rescue operation.*
Level 5	Identify an everyday need/problem experienced by someone around you. Brainstorm multiple solutions and choose one which can be solved with the help of a robot. Build and program your robot to prototype out the solution. *The student is expected to have gone through sufficient practical training on building and programming the robot.*

MAKER JR

"Free to imagine the future of computing."

Level 1

Experiment with any maker's kit.
Build a simple set-up which does at least 1 simple task when activated.

An example would be to make an LED light up, or make a buzzer sound.

Level 2

Enhance a set-up that you built to use at least 1 type of input/sensor.
Enhance a set-up that you built to use at least 2 different types of output devices.
Demonstrate how your set-up processes the information from the additional inputs/sensors and responds through the output devices.

An example of an input sensor would be the light sensor and examples of output devices would include motors and buzzers.

Level 3

Build a set-up which can accomplish at least one moderate task.
Program the logic for the set-up that you built to perform a fixed sequence of actions which accomplishes that task.
Ensure that the accomplished task involves decision-making based on information from the sensors.

An example would be to play a simple tune based on information from the sensor(s).

Level 4

Build a set-up which can accomplish at least 3 different complex tasks.
Program the logic for the set-up that you built to accomplish these different tasks depending on external inputs or selections.
Ensure that the accomplished tasks should involve analysis on the sensory information.

Examples of complex tasks would include making a display countdown from 10 to 0, changing an LED light from red to blue and back again in response to some sensory inputs.

Level 5

Identify an everyday need/problem experienced by someone around you. Brainstorm multiple solutions and choose one which can be solved with the help of a set-up.
Build and program a set-up to prototype out the solution.

The student is expected to have gone through sufficient practical training on building and programming the set-up.