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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Assessment # and title | | | | IPRIOT-AT2-PT1 Intermediate IoT: Portfolio Part 1 | | | | | | | | |
| **Lecturer name** | | | | *Adrian Gould* | | | | | | | | |
| **Student name** | | | | *Hyoin Lee* | | | | | | | | |
| **Student ID number** | | | | *20102711* | | | | | | | | |
| **Telephone contact number** | | | | *0432 105 240* | | | | | | | | |
| **Email** | | | | *20102711@tafe.wa.edu.au* | | | | | | | | |
| **By completing and submitting this signed form to my lecturer, I am stating that:**   1. The attached submission is completely my own work 2. I have correctly cited all sources of information used in this work (if required) 3. I have kept a copy of this assessment (where practicable) 4. I understand a copy of my assessment will be kept by the NMTAFE for their records 5. I understand my assessment may be selected for use in the NMTAFE’s validation and audit process to ensure student assessment meets requirements | | | | | | | | | | | | |
| **Student Signature** | | *Student to fill this section out* | | | | | | **Date** | | *Student to fill this section out* | | |
| Assessors please note: Where verbal clarification has been sought from a student to gather additional assessment evidence from an assessment item, question/s and response/s must be recorded, signed, and dated by the assessor, against the relevant assessment item/s. | | | | | | | | | | | | |
| NB: Feedback will be given via Blackboard when possible. | | | | | | | | | | | | |
| **Submission 1** | | Result | Satisfactory / Not Yet Satisfactory | | | | | | Date | | |  |
| *To satisfy requirements for this assessment, you need to complete the following:* | | | Feedback to student… | | | | | | | | | |
| **Submission 2** | | Result | Satisfactory / Not Yet Satisfactory | | | | | | Date | | |  |
| *To satisfy requirements for this assessment, you need to complete the following:* | | | Feedback to student… | | | | | | | | | |
| **Student Feedback** | | | Feedback from student… | | | | | | | | | |
| Lecturer Signature | | |  | | | | Student Signature | | | | |  |
| **Assessment type (🗹):** | | | | | | | | | | | | |
|  | Questioning (Oral/Written) | | | |  | 3rd Party Report | | | | |  | Practical Demonstration |
|  | Other – Project/Portfolio (*please specify on the right):* | | | | Portfolio of work covering power consumption, GPIO, Sensors, Actuators and general IoT. | | | | | | | |

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| --- |
| Requirements The base requirements for this assessment task may include one or more of the following:   * Web server, Python interpreter and database server * IDE or editor for developing Python programs (only PyCharm supported by the college) * Raspberry Pi with SenseHat or other IoT devices, like Arduino Uno or ESP32 * Access to Office 365 * Access to Microsoft Word * A calculator |
| Assessment Due This part of the portfolio assessment is split into components that have several due dates:   * Week 07 17:00 (5:00PM) on the day of the scheduled lecture.   Refer to Blackboard for most accurate dates, which may alter due to unforeseen circumstances.  Each part of the portfolio has a deadline for submission.  It is advantageous to you to attempt to meet the deadline provided.  We also will endeavour to update these document(s) at the same time. |
| Instructions Follow the steps listed in this assessment item.  Submission of the documentation, code, and associated items is at the end of each part of the portfolio. |
| Important If you are using a different configuration of tools and equipment for this assessment item, then assistance in this and subsequent parts of the portfolio to ensure the systems work correctly will be limited. |
| Scenario You are currently working for a small Perth-based start-up company called Incredibly Obvious Technologies.  They are looking to create a presence in the home automation and monitoring market.  Download and read the complete “Portfolio-Task-Scenario” from Blackboard. |
| General Instructions This document is to be used for submitting answers and evidence such as screen shots of your work.  Complete the document front page before continuing. |
| File Naming Conventions You are required to use a naming convention as outlined in Appendix XX.  Non-compliance will result in your attempt being deemed Not Yet Satisfactory. |
| Answering Questions When a step includes a question, you must attempt to answer it.  There is a minimum and maximum number of sentences to use for each answer.  All answer areas are provided with a recommended length of answer in sentences. These will vary in length.  Unless indicated, answers must be in complete sentences. |
| Sources of Information In industry, it is good practice to keep track of where information was obtained. This is especially true if it is a written document, or even code.  If you answer any questions using information from web sites, please include the site name and URL (Web site address) after the answer. Likewise, include the title and author for books and magazine articles. For example:   * RS Electronics Ltd: <https://au.rs-online.com/> * Slack API Documentation, Users List Method: <https://api.slack.com/methods/users.list> |
| Code Storage We advise that you create a GIT repository on GitHub and use this to store a copy of your work.  Make sure the Repository is PRIVATE.  You may also use OneDrive within your college Office365 to store a backup of your code or keep a copy on a USB thumb drive. |

| Step | Task to Perform |
| --- | --- |
| 00 | Familiarisation and Setting Up Familiarise yourself with the content of this assessment by reading the whole document at least ONCE before commencing.  As you progress through the steps contained in this assessment document, add your answers, screen shots and other evidence in the areas marked Axx where A stands for answer, and xx is the step number.  For example, Step 00 (this one) has an answer area of A00.  Ensure you have followed the instructions on creating the answer document, as given in the General Instructions.  Make sure that you complete the title page of the document.  At any stage during this assignment, you may consult the stakeholder(s) or their representative(s).  All answer areas are provided with a recommended length of answer in sentences. These will vary in length.  Unless indicated, answers must be in complete sentences. |
| A00 | No Answer Required  *This space left intentionally blank.* |
| 01 | Power consumption of IoT devices (1) Research power consumption of the following devices:   * Raspberry Pi 5 * Arduino Uno R4 Wi-Fi * ESP32 * Raspberry Pi Pico W * ESP8285 *or ESP8266*   The first point to find the details will be the Specifications or Data Sheet for the device.  For each device, the default supply voltage has been provided.  Please note that the reported current may be a range (minimum and maximum), in which case provide the range in the form minimum – maximum.  Identify the minimum and maximum current required for the device. If no minimum, use the same as the maximum for this.  For power consumption, calculate the minimum and maximum consumption based on the voltages and the current values found.  Always use the lowest current required that is not zero (as in the device is supplied with power). For example, this may be in hibernation mode.  Remember: V = I × R  P = V × I  Where: V = Voltage (V, Volts),  I = Current (A, Amps),  R = Resistance (Ω, Ohms),  P = Power (W, Watts)  Enter your results in the table in the answer area A01. |
| A01 | Power requirements for MCU, SBC, SOC, CPU and FPGA Complete the table with the information required for the devices indicated.  Note:   * Imin (mA) Current (Minimum, milli Amps) * Imax (mA) Current (Maximum, milli Amps) * Pmin (mW) Power Consumption (Minimum, milli Watts)  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | Type | Supply V | Circuit V | Imin (mA) | Imax (mA) | Pmin (mW) | Pmax (mW) | | Arduino Uno R4 | 6 - 24V | 5V | n/a | 40mA | n/a | 200mW | | ESP32-WROVER | 2.3 – 3.6V | 3.3V | n/a | 150mA | n/a | 495mW | | Raspberry Pi Pico W | 1.8 – 5.5V | 3.3V | n/a | 51mA | n/a | 168.3mW | | ESP8285 | 2.5 – 3.6V | 3.3V | n/a | 12mA | n/a | 39.6mW |   *Remove one of the ESP8285 or ESP8266 depending on which one you give data for.* |
| 02 | Power consumption of IoT devices (2)  1. What are some of the key drivers (components, subsystems) of power consumption in IoT devices? 2. Provide at least three examples and provide an estimate of how much power is consumed by each (in mW). 3. For at least TWO of your examples mentioned in answer b, explain how you may mitigate this problem.   Enter your answers in the area marked A02. |
| A02 | Power consumption of IoT devices (2)What are some of the key drivers (components or subsystems) of power consumption in IoT devices (one example: Wi-Fi)?  (3 – 6 examples are required)  1. Microcontroller Unit (MCU) 2. Sensors 3. Display 4. Network protocols  Provide **at least** three examples and provide an estimate of how much power is consumed by each (in mW). (3 – 6 sentences)  1. Low-power MCU consume around 1~10 mW during its active status and during in sleep mode it could drop to just a few micro-watt, depending on the MCU’s efficiency and configuration settings. 2. Power consumption of sensor varies widely depending on the type and mode. For example, light sensor might consume around 100-500 micro-watt during active measurement. 3. Power consumption of displays depend on the technology (LCD,OLED,etc). OLED displays can consume ranging from 100mW to several watts depending on the size and brightness level.  For at least TWO of your examples mentioned in answer b, explain how you may mitigate (reduce) the power consumption of the components?  (2 – 9 sentences total)  1. Selecting a MCU with lower-power consumption feature. 2. Selecting a sensor with trigger to wake up only when needed. 3. Choosing energy-efficiency display and reducing brightness level of the display. |
| 03 | Power consumption of IoT devices (3)  1. In your own words, describe how you can calculate the theoretical maximum running time of a device given the capacity of a rechargeable battery. 2. What is the formula for calculating battery life (worst case scenario)? 3. Based on the results from Question 1, determine how long each device can run on various battery capacities.   Presume you are powering the device at its maximum current requirement with no external devices connected.  Presume the batteries are charged to their theoretical maximum, they are able to power the device until their charge is zero, and that the battery supplies the required voltage to the device. 4. Practically, batteries are not able to be charged to 100% and they have a minimum charge to allow them to function (and to be recharged).  For the battery in this task, it may supply the device until its charge is 1050mAh, at which point the battery’s electronics will shut down supply.  Also, when charged, the battery will not be able to supply its indicated maximum as charging is stopped to prevent damage to the battery. For this situation, assume you have an effective maximum charge of 95% of the indicated value.   You may also assume that each battery has the correct supply voltage for each device.   Use the details above to calculate a “minimum” time for the devices to be run using the batteries.  Complete the table in the answer area. |
| A03 | Power consumption of IoT devices (3)In your own words, describe how you can calculate the running time of a device given the capacity of a rechargeable battery.  (3 – 10 sentences) To calculate the running time of a device given the capacity of a rechargeable battery, I need to consider the power consumption of the device and the capacity of the battery. First, battery capacity is usually measured in milliampere-hour(mAh) or watt-hour(wh) and power consumption is measured in watts(W) or milliwatts(mW). Once we have these values, we can use the formula ‘Running time’(hour) equal ‘Batter capacity’ divided by ‘Device power consumption’.  Running time(hours) = (Battery capacity / Device power consumption) Formula for calculating battery life (worst case scenario) In a worst-case, we can estimate the battery life of a device by considering the battery’s capacity and the device’s maximum power consumption. The formula for calculating the battery life in the worst-case scenario is that the battery life is battery capacity divided by Maximum power consumption of the device. Battery Life Table (To be completed)  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Device Type | Current Drain (max) | Battery capacities and supply scenarios | | | | | 8000 mAh (theoretical max) | 8000 mAh (reality) | 20000 mAh (theoretical max) | 20000 mAh (reality) | | Raspberry Pi Pico W | 168.3mW | 47.53h | 39.62h | 118.83h | 100.71h | | Raspberry Pi Zero 2 W | 230mW | 34.78h | 28.48h | 86.95h | 73.7h | | Arduino Uno R4 WiFi | 200mW | 40h | 32.75h | 100h | 87.75h | | ESP8285 / ESP8266 | 39.6mW | 202.02h | 165.40h | 505.05h | 428.03h | | ESP32-WROOM | 495mW | 16.16h | 13.23h | 40.4h | 34.24h |  Effective maximum charge of 95%Bottom limit battery capacity for recharge 1050mA |
| 04 | Reducing power consumption in IoT devices In your own words, describe the following power reduction strategies and name at least one disadvantage of each strategy:   1. Sleep 2. Deep Sleep 3. Hibernation   Enter your answers in the A04 area. |
| A04 | Reducing power consumption in IoT devices  * Each answer to have between 2 and 5 sentences. * Explain what each method does to reduce power consumption. * Give at least ONE disadvantage for each of the power reduction methodologies, attempting to make a clear distinction in the disadvantage(s) between each one.  Sleep Sleep mode is a power-saving state by temporarily halting non-essential functions while remaining operational. It allows the device to quickly resume normal operation when needed. One disadvantage is that some background tasks may continue to run consuming a small amount of energy. Deep Sleep Deep sleep mode is an advanced power-saving state where device enters an even lower power consumption state compared to regular sleep mode. In deep sleep mode, the device shuts down most of its components, including CPU and peripherals, to minimize power consumption further. However, a disadvantage of deep sleep is that it takes longer for the device to wake up and resume normal operation compared to regular sleep mode due to reinitializing components. Hibernation Hibernation is a power-saving mode primarily used in computers, where the system saves the current state of the operating system and shuts down completely. Hibernation significantly reduces power consumption since the device is essentially powered off. However, one disadvantage of hibernation is that the process of saving and restoring the system state can take longer compared to sleep or deep sleep modes, resulting in slower wake-up times. |
| 05 | Simple sensors For your first prototype, you are looking into detection to determine if a garage door is left open.  You want to use a ‘reed switch’ for this purpose.  This sensor contains a magnetically activated lever inside a glass tube. A small magnet opens the switch by bending the metal lever away from the contact.  A magnet with a red and white object  Description automatically generatedA screen shot of a phone  Description automatically generated  Answer the following questions:   1. In your own words, describe the operation of a reed switch and how you can use it to detect the open/close state of a door. 2. In your own words, describe how you might integrate this sensor (reed switch) to any one of the following devices:    * Raspberry Pi 4B    * Raspberry Pi Zero W    * Arduino Uno    * ESP32    * Raspberry Pi Pico W    * ESP8285    * ESP8266   The use of diagrams is allowed/encouraged to assist your answer. |
| A05 | Simple sensorsIn your own words, describe the operation of a reed switch and how you can use it to detect the open/close state of a door. (1 to 5 sentences) A reed switch operates based on the principle of magnetism. When a magnetic field is applied to the switch, it causes the reed to bend and make contact with another metal strip, completing the circuit and allowing current to flow. In reverse, when the magnetic field is removed, the reed returns to its original position, breaking the circuit and stopping the flow of current.  To use a reed switch to detect the open/close state of a door, I would install the switch such that when the door is closed, a magnet mounted on the door comes close enough to the switch to activate it and when the door is open, the magnet moves away from the switch. Integrating a reed switch with a IoT device. Diagrams are allowed/encouraged to assist your answer. (2 – 5 sentences) Connect one terminal of the reed switch to any digital pin on the Arduino.  Connect the other terminal of the reed switch to a GND pin on the Arduino.  Open the Arduino IDE and create a code script.  Use the ‘pinMode()’ function to configure the digital pin connected to the reed switch as an input.  Use the ‘digitalRead()’ function to continuously monitor the state of the digital pin connected to the reed switch.  Based on the state read from the pin(HIGH or LOW), take appropriate actions. |
| 06 | External sensor “data” and IoT devices Sensors can deliver their readings in two forms.  One way is by digital signal, the other is by analogue signal.  Describe what is meant by the terms digital signal and analogue signal.  Identify an advantage of each type of signal.  You may illustrate your answer by using a simple sensor connected to an IoT device via GPIO.  Complete your answer in the A06 area on the following page. |
| A06 | External sensor `data` and IoT devicesWhat is a Digital Signal, and what is an advantage of this type of signal?  (2 – 6 sentences) A digital signal typically represents specific values or states. These signals are characterized by distinct voltage levels that correspond to logical high (1) and logical low (0). An advantage of digital signals is that they’re less likely to get mixed up or misunderstood compared to more complicated signals. What is an Analogue Signal, and what is an advantage of this type of signal?  (2 – 6 sentences) An analogue signal can be represented as a form of data where information is conveyed through physical quantities such as voltage, current, or frequency. Unlike digital signals, analogue signals can have an infinite number of possible values within a range. An advantage of analogue signals is their ability to provide a high level of precision and detail. |
| 07 | Pull-Up and Pull-Down Resistors What is meant by a “floating signal”?  There are two ways to use a resistor to solve the floating problem using either a pull-up or a pull-down resistor.  In your own words, describe what the purpose of connecting a GPIO to these resistors, and what it achieves when there is no external signal applied to the GPIO:   1. a pull-up resistor, 2. a pull-down resistor.   Complete your answers in the A07 area on the following page. |
| A07 | Pull-Up and Pull-Down ResistorsWhat is meant by a “floating signal”?  (1 – 2 sentences) Floating signal is like a situation where a digital input of device is not actively driven to a specific logic level which could lead to an undefined state. Purpose and effect of Pull-up resistor and the effect when no external signal is present on the GPIO. (2 – 4 sentences) Pull-up resistor is used to solve the floating problem by connecting the input pin to a voltage source through a resistor. When no external signal is present on the GPIO, the pull-up resistor makes sure that the pin is pulled to a logic high state, preventing it from floating and providing a defined default state. Purpose of Pull-down resistor and the effect when no external signal is present GPIO.  (2 – 4 sentences) Pull-down resistor is similarly used to solve the floating problem as well by connecting the input pin to ground (GND) through a resistor. When no external signal is present on the GPIO, the pull-down resistor makes sure that the pin is pulled to a login low state for the same reason, preventing floating problem and providing a defined default state. |
| 08 | GPIO GPIO is the acronym for ‘General Purpose Input/Output’, meaning that pins can be configured as input or output.  In your own words, describe why GPIO pins are configured as inputs by default within the hardware of a microprocessor/microcontroller.  Complete your answers in the A08 area on the following page. |
| A08 | GPIOWhy are the GPIO pins on IoT devices configured as inputs by default? (1 – 5 sentences) Configuring GPIO pins as inputs by default provide flexibility in their usage as user can easily repurpose the pins for various tasks. In an aspect of safety, when left unconfigured, GPIO pins default to high-impendence state, which means they have minimal current flow. This minimizes the risk of accidentally shorting or damaging the pins when connecting external devices. Input pins consume less power compared to output pins. |
| 09 | GPIO, SPI, ADC/DAC and I2C Many IoT devices are run by “system on chip” (SOC) which provide a lot of interfacing capabilities.  Raspberry Pi provides a 26- or 40-pin header that provides the connectivity to some, or all, of these capabilities.  What is I2C, and why is I2C so useful for IoT?  What is SPI?  What does the term “multiplexing” mean in the context of IoT, and how could it be useful in IoT?  Complete your answers in the A09 area on the following page. |
| A09 | GPIO, SPI, ADC/DAC and I2CWhat is I2C and why is it so useful in IoT? (2 – 8 sentences) I2C stands for Inter-Intergrated Circuit and is a serial communication protocol commonly used in IoT devices for connecting peripherals and sensors to a microcontroller or SOC(system on chip). It allows multiple devices to communicate with each other using two wires (clock and data), which makes it ideal for connecting a large number of devices in IoT applications. I2C is useful for IoT because it enables efficient communication between various components within a system, simplifies wiring, and conserves GPIO pins, which is crucial for devices with limited I/O resources. What is SPI? (1 – 5 sentences) SPI stands for Serial Peripheral Interface and is another serial communication protocol commonly used in IoT devices. Unlike I2C, SPI typically requires more wires (at least four) for communication, a clock signal, a data input, a data output, and a chip select signal for each device. SPI is useful for IoT because it offers higher data transfer rates and supports full-duplex communication. What is Multiplexing and how could it be useful in IoT? (1 – 5 sentences) Multiplexing can refer to various methods of sharing limited hardware resources, such as GPIO pins or analogue input/output channels, among multiple devices or sensors. Multiplexing is useful in IoT because it allows efficient utilization of limited hardware resources, reduces component count, and lowers costs. It enables IoT devices to support a large number of peripherals and sensors without requiring additional hardware, making them more versatile and cost-effective. |
| 10 | Simple Actuators In a second prototype, using an Arduino you are to activate a small water pump every 10 minutes for 20 seconds. The pump is rated at 5.0V and 0.175A. It can lift water up to 50cm above its base and requires at least 1V to start. It has a maximum flow rate of 80 litres/hour (l/h).  The power is supplied by a 100000mAh Lithium Polymer battery that has a max charge of 90% of the listed capacity and a minimum charge of 1500mAh before supply cut off to prevent damage to the battery.  With the scenario above, and the  Answer the following questions:   1. What is the power use of the Pump when running at full capacity? 2. When using a GPIO on an Arduino, is the GPIO able to supply the required voltage and current to run the pump? 3. If the GPIO on the Arduino is not able to supply the required current and voltage, how could you modify the circuit to provide the pump’s requirements? 4. In a theoretical scenario, you are running the Arduino Uno and the Pump together with the pump being on continuously. If you use the theoretical maximum capacity, how long will the battery power the device until zero charge? 5. You are running the Arduino Uno and the Pump together with Arduino on continuously and the pump being on for 15 seconds every hour. Presume that any additional circuitry does not affect the power requirements.  How long will a battery of capacity 100000mAh power the device from full capacity to zero? 6. Batteries (LiPo, NiCad and others) generally have a “low point” that stops them from providing power until they are totally flat. Likewise, they generally do not deliver their full rated capacity.   If the above 20000mAh battery “disconnects” and is unable to run the device at a capacity of 2500mAh and it may only provide 85% of the maximum capacity, how long will the Arduino and pump be able to be run before there is not enough power? Again, presume the additional circuitry does not affect the power requirements. |
| A10 | Simple ActuatorsWhat is the power use of the Pump when running at full capacity?  * P=VI   So, Power is 5.0V X 0.175A which is 0.875W Is the Arduino able to supply the required voltage and current to the pump (yes or no)?  * No   *Presume the GPIO is not able to supply the voltage and current for the pump, how would you modify the circuit to be able to provide the needs of the actuator? (1-10 sentences, diagrams encouraged)*  To modify the circuit to provide the pump’s requirements, I can use a transistor as a switch. Connect the GPIO pin to the base of the transistor and connect the pump to the collector of the transistor. The Arduino can then control the transistor, allowing it to switch the pump on and off while supplying the necessary voltage and current. How long will a battery of capacity 20,000mAh power the Arduino Uno and Pump is they both are continuously on? (any additional circuitry that may be required may be ignored)  * To calculate the theoretical maximum runtime of the Arduino Uno and the pump together with the pump being on continuously, divide the battery capacity by the combined power consumption. * Power consumption of Arduino Uno: P=VI = 5V \* 40mA = 200mW * Power consumption of the pump: P=VI = 5V \* 175mA = 875mW * Total power consumption of both devices = 200mW + 875mW = 1075mW = 1.075W * Runtime(hour) = Battery capacity / Total power consumption * Battery capacity = 20,000mAh \* 5V = 20Ah \*5V = 100Wh * Runtime = 100Wh / 1.075W = 93.02h  Using the same battery, and other conditions, how long will the battery run the Arduino and pump if the Arduino is on continuously, but the pump is activated for 15 seconds every hour?  * Power consumption of Arduino Uno: P=VI = 5V \* 40mA = 200mW * Power consumption of the pump: P=VI = 5V \* 175mA = 875mW * Power consumption of the pump per hour = 875mW \* (15s/3600s) = 3.6mW = 0.0036W * Total power consumption of both devices = 200mW + 3.6mW = 203.6mW * Runtime(hour) = Battery capacity(mWh) / Total power consumption(mW) * Battery capacity = 20,000mAh \* 5V = 100,000mWh * Runtime = 100,000mWh / 203.6mW = 491.16hours  How long will the 20,000mAh battery provide power to the Arduino and Pump “disconnects” at a capacity of 2500mAh and can only provide 85% of the maximum capacity, how long will the Arduino and pump be able to be run before there is not enough power? (Arduino and pump are continuously on)  * Actual capacity = Maximum capacity \* Recharging efficiency   = 20,000mAh \* 0.85 = 17,500mAh   * Remaining capacity = Actual capacity – Disconnect capacity   = 17,500mAh – 2500mAh = 15,000mAh   * Runtime(hour) = Remaining usable capacity / Total power consumption   = 15,000mAh / (40+175) mA = 69.767h |
| END | Submission of Portfolio Work To submit the portfolio, do the following:   * Save this document with your answers as a MS Word file (.docx). * Export this document as a PDF file  (Windows: Use File 🡪 Print 🡪 Select printer: “Microsoft Print to PDF”). * DO NOT add the Word Document and PDF to a compressed file. * Open Blackboard and locate the AT2 Portfolio Task 1 assessment. * Open the assessment and upload the Microsoft Word and PDF documents. * Click submit.   Whilst there is no need to use any other word processing software as you have access to Office 365 for free as a student, if you use Apple Pages, or Open Office, we will then require you to upload the original file **AND** a PDF version. |

# appendix A: Terminology

|  |  |
| --- | --- |
| Term | Definition |
| … |  |
| Camel Case | First letter is lower case, every first letter of a new word is Upper case. No Spaces or other punctuation characters between words.  thisIsCamelCase |
| Kebab Case | Words are all lower case with dashes/minus signs (-) between words. No spaces or other punctuation characters between words.  this-is-kebab-case |
| Lower case | The anglophile small letters a through to z.  a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, u, v, w, x, y, z |
| Pascal Case | Every first letter of a word is Upper case. No spaces or other punctuation characters between words.  ThisIsPascalCase |
| RTFM | Read The Flipping Manual |
| Shouty Kebab Case | Words are all upper case with dashes/minus signs (-) between words. No spaces or other punctuation characters between words.  THIS-IS-SHOUTY-KEBAB-CASE |
| Shouty or Angry Snake Case | Words are all capital letters with underscores (\_) between words. No spaces or other punctuation characters between words.  THIS\_IS\_SHOUTY\_SNAKE\_CASE |
| Snake Case | Words separated by an underscore (\_). No spaces or other punctuation characters between words.  this\_is\_snake\_case |
| TBA | To be advised |
| TBD | To be determined |
| Upper Case | The anglophile capital letters A through to Z.  A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z |
| Number | A numerical value using the digital 0 through to 9 and an optional single decimal point, with an optional minus sign (-) in the first position to indicate a negative number.  123.456  9876  0 |
| … | … |

# Appendix B: File Naming Conventions

The following are the naming conventions for code, folders and other documents unless otherwise contradicted by instructions in the assessment item.

## General Rules

Folders must be named using lower case letters, the numbers 0-9 and the dash/minus sign (-) ONLY.

No spaces to be used in any file or folder names at any time.

## PHP

Filenames to be in camel case, with .php at the end.

Stick to one convention, and do not change, unless the framework or similar dictates a different convention. See exceptions.

### Exceptions:

Files with classes must be Pascal Case.

Template files for blade and other engines will end with .blade.php or similar (engine dependant).

### Examples:

|  |  |
| --- | --- |
| Ordinary PHP file | this-is-a-php-code-file.php |
| File with Class definition | CarController.php |

## C/C++

Filenames to be in snake case ending in .c (source files) or .h (header files). See exceptions.

### Exceptions:

Arduino code files usually end in .ino (source) and .h (header).

### Examples:

|  |  |
| --- | --- |
| Ordinary PHP file | this-is-a-php-code-file.php |
| File with Class definition | CarController.php |

## HTML, CSS and JavaScript

Filenames to be in kebab case.

They will end with .html (HTML file), .css (CSS File) or .js (JavaScript file).

### Exceptions

Some HTML/CSS/JS frameworks have specialised extensions. Ensure you always follow the framework guidelines. Examples below.

|  |  |
| --- | --- |
| React | .jsx |
| SASS | .sass, .scss |

### Examples:

|  |  |
| --- | --- |
| HTML file | home.html |
| CSS File | Rest.css  site-styles.css |
| JavaScript File | app.js |

## Python

Filenames are to be in snake case ending in .py (source files). See exceptions.

### Exceptions:

TBD

### Examples:

|  |  |
| --- | --- |
| Ordinary PHP file | this-is-a-php-code-file.php |
| File with Class definition | CarController.php |

## C#

Filenames to be in snake case ending in .cs (source files) or .h (header files). See exceptions.

### Exceptions:

TBD

### Examples:

|  |  |
| --- | --- |
| Ordinary PHP file | this-is-a-php-code-file.php |
| File with Class definition | CarController.php |

# Appendix C: Code Style Guidelines

## C/C++/Arduino, C#

To be determined

## HTML/CSS/JS

To be determined

## PHP

To be determined

## Python

Your code will follow the PEP 8 standard.

Readability Counts  
- Zen of Python

Explicit is better than implicit.  
- Zen of Python

Other code standards available in the Presentation, “Python Coding Standards for North Metropolitan TAFE”.