Template

Apprentice Name	Peter Metcalfe
Apprenticeship Standard	Digital & Technology Solutions
Location *(where activity took place)*	DSTL, Porton Down
Date or time period	2024 September - December
Witness Name	Raj Getalal
Contact details *(email address)*	RMGETALAL@dstl.gov.uk
Relationship to Apprentice	Robotics Supervisor
Description of activity	A 4 month placement at DSTL, involving extensive robotics work.
KSBs Witnessed	**CS17:** Can plan, design and manage computer networks with an overall focus on the services and capabilities that network infrastructure solutions enable in an organisational context. **CB7:** Applies analytics and critical thinking skills to Technology Solutions development and systematically analyse and apply structured problem solving techniques to complex systems and situations. **CB8:** Able to put forward, demonstrate value and gain commitment to moderately complex technology-orientated solution, demonstrating understanding of business need, using open questions and summarising skills and basic negotiating skills. **CB9:** Able to conduct effective research, using literature and other media into IT and business related topics. **CB13:** A thorough approach to work. **CB14:** Logical thinking and creative approach to problem solving. **SEK6:** How to use and apply the range of software tools used in Software Engineering. **SES3:** Produce high quality code with sound syntax in at least one language following best practices and standards.

Witness Testimony

During his 4 month placement at Dstl, Peter worked under my supervision and contributed towards a number of research strands within my robotics project. Working alongside another apprentice, Peter learnt how to use a 6-axis Collaborative Robot (Cobot) arm, developed by Universal Robots, to complete a range of research, development, testing and evaluation activities.

The main task that Peter contributed towards was the creation of “Catalogues”. The purpose of these “Catalogues” was to provide succinct descriptions of the Cobot arm, as well as any accessories (i.e. gripper, camera, force/torque sensor etc.) associated with it, to enable end users to get a better understanding of its capabilities.

To aid the generation of the Catalogues, Peter created simulations of the Cobot arm using MATLAB. Here, he made use of the 3D modelling environment to generate a point cloud map that simulated the Cobot arm’s maximum workspace envelope.

Furthermore, Peter also conducted extensive testing and evaluation of the gripper, where he demonstrated the variable applied force and grip; vision system, in which he identified how to locate randomly placed objects of different sizes and colours; as well as the Hex-QC sensor, where used it to measure the force/torque values exerted in different axes when undertaking a task.

Beyond this, Peter also went on to setup an Nvidia Jetson Orin AGX developer kit to control the Cobot arm in a remote manner. This involved Peter having to find the correct network setup to communicate with the Cobot over an Ethernet connection, as well as a developing a Python script to send commands.

Finally, Peter was able to implement Inverse Kinematics (IK) on the Nvidia Jetson Orin AGX developer kit, using Python. By applying his understanding of trigonometry, Peter was able to implement an algorithm that

enabled him to precisely control the movement of Cobot arm and gripper in the Cobot Joint space using a Cartesian (i.e. X, Y, Z) co-ordinate system that described where he'd like the Cobot arm to move to.

Core Skill 17:
Peter demonstrated his ability to plan and manage the implementation of a network infrastructure, on a small scale, to enable communications to occur between the Cobot arm and the Nvidia Jetson Orin AGX developer kit. He achieved this by making use of appropriate hardware (i.e. network router and switch) as well as identifying the correct IP address, gateway address and subnet mask required to establish a stable connection between the two devices.

Core Behaviour 7:
Peter encountered several complex problems during his time on the project and clearly demonstrated his ability to think critically in order to solve them. For instance, when tackling the Inverse Kinematics (IK) problem, he systematically applied his foundational mathematics knowledge to develop a set of formulae that would enable him to control each axis of the Cobot arm independently.

Core Behaviour 8:
Robotics can be a complex subject to grasp and yet Peter was able to learn quickly and demonstrate his understanding, resulting in him providing genuine value to the project team. In particular, Peter was able to summarise and share his ideas in a clear and succinct manner, provide simple explanations to complex issues along with asking open questions in response to topics that he was unclear or unfamiliar with.

Core Behaviour 9:
While creating catalogues for the robot, Peter conducted extensive research, collating materials from a range of sources. These included online reports and literature as well as user manuals and guides. He then summarised these into an easily digestible format which then saved others from having to read through the entirety of the source material.

Core Behaviour 13:
Throughout Peter's time spent under my supervision, he demonstrated an exceptionally thorough and methodological approach to his work. He regularly took the time to ensure his reports and presentations were written to a high standard, ensuring the technical content was correct and accurate as well as minimising any grammatical mistakes where possible.

Core behaviour 14:
Peter tackled several complex problems during his time working on my project. When tackling each problem, he demonstrated his ability to think both logically and creatively to solve the issue. For example, when solving the networking issue discussed previously, Peter offered unique perspectives that hadn't been considered initially, such as connecting the Nvidia Jetson Orin AGX developer kit directly to the Cobot arm control box, bypassing the network switch and router entirely, which went on to be the correct approach for establishing communications. Another example is the Inverse Kinematics (IK) problem also previously discussed, where Peter thought very logically and applied his foundational mathematical understanding to identify the correct formulae required to calculate the Cobot joint angles.

Software Engineering Knowledge 6:
To complete the various tasks Peter undertook on my project, he made use of a range of software tools and packages such as PolyScope, Python, MATLAB, Linux, text editors, the source code inspector function within web browsers and the command line terminal.

Software Engineering Skill 3:
Peter developed code in both MATLAB and Python. MATLAB was used for simulations and modelling, Python was used for controlling the Cobot. Both of these programming languages were used to generate code scripts to a high standard, following best practices and commented extensively.

	Signature	18/12/2024 X  Signed by: Getalal Rajan M

Witness Testimony Template

Apprentice Name	Peter Metcalfe
Apprenticeship Standard	Digital & Technology Solutions
Location *(where activity took place)*	DSTL, Porton Down
Date or time period	2024 September - December
Witness Name	Caitlin Haddow
Contact details *(email address)*	chaddow@dstl.gov.uk
Relationship to Apprentice	Placement Supervisor
Description of activity	A 4 month placement at DSTL, with extensive work on image analysis.
KSBs Witnessed	CK1: How the business exploits technology solutions for competitive advantage. CK3: Contemporary techniques for design, developing, testing, correcting, deploying and documenting software systems from specifications, using agreed standards and tools. CK4: How teams work effectively to produce technology solutions. CK9: How to deliver a technology solutions project accurately consistent with business needs. CS3: Designs, Implements, tests, and debugs software to meet requirement using contemporary methods including agile development. CS9: Is able to manage data effectively and undertake data analysis. CS15: Applies industry standard processes, methods, techniques and tools to execute projects. CB6 Able to give and receive feedback constructively and incorporate it into their own development and life-long learning. CB9: Able to conduct effective research, using literature and other media into IT and business related topics. CB12: Ability to perform under pressure. CB13: A thorough approach to work. SEK2: How teams operate effectively to develop software solutions embracing agile and other development approaches. SEK4: How to interpret and implement a design, compliant with functional, non-functional and security requirements. SEK6: How to use and apply the range of software tools used in Software Engineering. SES3: Produce high quality code with sound syntax in at least one language following best practices and standards.

Witness Testimony

During Peter's four month placement at DSTL, I have witnessed him take part in two major pieces of work; Automated Image Analysis and Neuromorphic Processing research.

For the image analysis, Peter worked along-side another apprentice to develop a Python script that could parse dataset(s) of images and their corresponding bounding boxes as XML data, perform a series of computer vision techniques, and output a spreadsheet labelling each image and its features. They then developed an additional script to generate graphs for statistical distributions to visualise the labels. 'Sphynx' was used for automated documentation, and virtual environments for dependency management.

The neuromorphic research involved Peter working in a small team for one 'sprint' (Agile methodology), where the processing and collection of neuromorphic event-based data was explored. Peter performed research into existing data sets and their suitability/relevance, developed a script to load this data and output the encoded events in the format 'x, y, t, p', and developed a script to perform voxel-encoding/pre-processing, where data is scaled and discretised before being used to train a model.
Peter also contributed to the collection of new neuromorphic data. He programmed a Cobot arm to perform different actions as they were recorded by a neuromorphic event-based camera.

Core Knowledge 1:
Peter took the opportunity to work on the modern technologies mentioned above, and has therefore gained an insight into how the business is utilising them. I believe Peter demonstrated this by developing solutions with said technologies, such as the neuromorphic pre-processing.

Core Knowledge 3:
Using the image analysis Python as an example, where I gave certain specifications, Peter contributed to the design, development, testing and documentation. He made use of object orientated programming (OOP), kept to the PEP8 standard for Python development and made use of tools such as virtual environments, all as agreed.

Core Knowledge 4:
Peter was able to work collaboratively with the rest of the neuromorphics team to produce a piece of research that will enable this project to be taken further.

Core Knowledge 9:
Peter was able to work independently when required to develop software and deliver a working solution. The image analysis script being a good example where Peter demonstrated this. This was required by the business and was executed with high quality and accuracy.

Core Skill 3:
As demonstrated in both the image analysis and pre-processing examples, Peter was able to design, implement, test and debug software effectively and deliver working solutions. And more specifically, the neuromorphic pre-processing solution was developed in line with the agile methodology, as, as a team, we worked in a sprint with daily stand-up meetings and work item planning.

Core Skill 9:
The image analysis task allowed Peter to fully demonstrate his ability to manage and analyse data effectively. With an entire dataset of images, Peter was able to organise, parse, process and analyse them, resulting in visual and useful statistical charts that could be used to inform further decisions about the dataset.

Core Skill 15:
Again, in the image analysis Python script, Peter applied industry-standard methods and tools such as following PEP8 coding standards and using OOP. Peter also utilised virtual environments to manage dependencies and Sphinx for documentation. Additionally, by participating in code reviews, his code maintained a higher standard. I believe, this demonstrates Peter's ability to execute projects efficiently and professionally.

Core Behaviour 6:

Peter positively received constructive feedback during coding and documentation reviews and implemented suggested changes to improve the scripts and documentation. This has benefited his long-term proficiency in coding skills. Peter asked good clarifying questions to better understand and implement changes.

Core Behaviour 9:
Peter clearly demonstrated effective research into neuromorphic datasets. He discovered a couple of reports that were key for the team's understanding as wells as a couple of important neuromorphic datasets.

Core Behaviour 12:
During the team's sprint, there was a very tight deadline to keep to. However, Peter was unfazed and delivered everything that was required of him, with a high standard.

Core Behaviour 13:
Both the examples discussed above can be used to demonstrate Peter's thorough approach to work. He always delivered, code was of a high quality and he would always ask for more details where necessary.

Software Engineering Knowledge 2:
During the work on neuromorphic processing, Peter worked in a team performing an agile sprint. Peter was able work well as part of this team, embracing the agile methodology.

Software Engineering Knowledge 4:
During the image analysis work, both deliverables were compliant with the informal functional requirements that were provided before development. The requirements detailed the functionality of all the label types.

Software Engineering Knowledge 6:
Peter made use of a range of software tools including: terminal, virtual environments, Python, VS Code, Sphynx, URScript and various other Python libraries including: Matplotlib, Numpy, Pillow, OS, Tonic, AEDAT, LabelImg.

Software Engineering Skill 3:
As already discussed, Peter developed several Python scripts following the PEP8 standard and made use of OOP. His code was of a high standard and well documented.

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