# Course Design Template

# Final assignment

Read page 5 in the Course Design Handbook and complete your final assignment outline in the box below.

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| ***Action 1: Final assignment title***  **Will medical professionals be replaced by machines?** |
| ***Action 2: Details of final assignment***  *(e.g. essay, lab report, problem set? Include word count where relevant)*   * Discuss the current status of robotics in medicine, and evaluate their applications in diagnosis, surgery, cancer treatment, and rehabilitation. * Do you think that in the future, robots will replace human medical professionals? Describe one application where you think this is particularly relevant. * Justify your answer with reference to the ethical implications. * Each pupil will produce:   + An evaluation of at least 4 types of medical robots currently employed in one or more of diagnosis, surgery, cancer treatment, and rehabilitation (1200 words).   + A reasoned hypothesis of the future status of robotics in medicine and the ethical implications (800). * In the feedback tutorial I will split the group into two and each side will argue for and against robotic medicine. |

# Course mark scheme

Please read pages 6-7 in the Course Design Handbook and use the template below to draw up a mark scheme specific to your final assignment. You will need to refer to the appendices relevant to your subject.

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| **Key Skill** | **1st** | **2.2** | **3rd** |
| Communication | * Writing is coherent and organised following a logical sequence. * Almost faultless spelling, punctuation and grammar. * Writing follows the style of a medical imaging guidance document. | * At times the writing is poorly organised with a lack of coherent structure. * The spelling, punctuation and grammar are weak in places. * Inconsistent use of style throughout resulting in lack of clarity. | * Writing is poorly organised with a lack of logical structure. * The spelling, punctuation and grammar are weak. |
| Contextualising | * At least four types of medical robot are clearly evaluated. * For each robot, the advantages, disadvantages and ethical considerations are described. * Additional sources are used to support the discussion. | * Attempts to describe four medical robots, but no clear evaluation. * Attempts but no clear discussion on the advantages, disadvantages and ethical considerations of robots. * Little reference made to additional sources. | * No clear description of four medical robots. * No clear discussion on the advantages, disadvantages and ethical considerations of robots. * No reference to additional sources. |
| Application | * Evaluates the robots in ways that have not previously been discussed. * Discusses the robotic concepts from the tutorials in an unfamiliar context, and does so accurately and confidently. * Avoids the use of irrelevant facts and arguments to arrive at a final conclusion. | * Needs direction to evaluate the robots in ways that have not previously been discussed. * When directed, discusses the robotic concepts from the tutorials in an unfamiliar context, and does so with reasonable accuracy. * Occasionally introduces irrelevant facts and arguments to arrive at a final conclusion. | * Some weak attempts to evaluate the robots in ways that have not previously been discussed. * Struggles to apply the robotic concepts from the tutorials in an unfamiliar context. * Introduces irrelevant facts and arguments to arrive at a final conclusion. |
| Logical reasoning | * The flow of argument is logically structured and easy to follow. * Arguments and reasoning are expressed with clarity to arrive at a final conclusion. | * A flow of argument is attempted, but there are some unnecessary or illogical steps and the structure is not necessarily easy to follow. * There is a lack of clarity within arguments and reasoning used to arrive at a final conclusion. | * The flow of argument contains mistakes and has an illogical structure. * A final conclusion may be attempted but may be unclear. |
| Critical thinking and evaluation | * Conclusions regarding the typical use of each robot, and their suitability for different applications and patients, are well reasoned and clearly supported by facts. * The limitations and ethical considerations of each type of robot are considered where appropriate. | * Some conclusions regarding the typical use of each robot, and their suitability for different applications and patients, but insufficient reasoning and may be unsupported by facts. * Some consideration of the limitations and ethical considerations of each type of robot. | * A weak argument can be made for the typical use of each robot, and their suitability for different applications and patients, but this may be incorrect in places. * Little consideration of the limitations and ethical considerations of each type of robot. |

You should select a manageable number of skills to assess – we suggest choosing between 3-5 skills.

# Course Rationale

Please read page 7 in the Course Design Handbook and complete your course rationale in the box below.

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| Medical technology, artificial intelligence, and robotics are important parts of healthcare and will affect all of us at some point in our lives.  From previous course on medical imaging:  Medical imaging is an important part of healthcare and will affect all of us at some point in our lives. Methods such as ultrasound and x-ray imaging are used routinely in hospitals all over the world, and enable clinicians to accurately diagnose disease, monitor disease progression and check the success of treatment. Clinicians have to decide the best imaging method to use for their patients and sometimes the choice can be difficult. Throughout the course the pupils will develop the knowledge, critical thinking and logical reasoning required to tackle these decisions.  Two of the tutorials will focus on the principles and applications of four major imaging techniques: MRI (Magnetic Resonance Imaging), PET (Positron Emission Tomography), x-ray imaging and ultrasound scans. The pupils will interview someone who has experienced some form of medical imaging and thus gain an appreciation of the patient’s perspective. Other methods, such as those using light to see inside the body, will also be mentioned, and there will be opportunities for hands-on interaction with medical equipment.  In two further tutorials, the pupils will develop the ability to compare the different imaging methods and evaluate their advantages and disadvantages. We will consider factors such as imaging risks, the affected body part, and the disease type and use these to draw up a decision-making flow diagram.  The final assignment will address the question: “what is the best way to see inside the human body?” Each pupil will be given a different case study describing someone with an injury or medical condition, and will work through their flow diagram in order to decide the most suitable imaging method.  By the end of the course, the pupils will be able to explain the main imaging methods used in hospitals today and to assess their suitability for different diseases and conditions. These skills are helpful in a world where healthcare plays such a key role, and are especially valuable for anyone hoping to pursue a medical-related career. |

# Tutorial 1 (40 minutes)

*Read steps 4-8 on pages 8-15 in the Course Design Handbook and complete your tutorial plans.*

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| **What is the purpose of the tutorial?**  Introduction to medical robotics |
| **What content will the pupils be studying?**  An overview of different medical robots used in diagnosis, surgery, treatment, and rehabilitation.  The distinction between robotic / non-robotic.  Put medical robotics into context by drawing on examples/experiences of pupils in the group. |
| **What skills will the pupils be demonstrating?**  Contextualisation: how medical robots fit into the bigger picture of disease and injury diagnosis and treatment. |
| **What are the key questions?**   * What medical technologies are commonly used for diagnosis, surgery, treatment, and rehabilitation? * What is the difference between medical technology and medical robotics? |
| **What resources and activities will you use?**  I’ll bring along a pulse oximeter, a stethoscope, and a handheld Doppler ultrasound to demonstrate.  Starter (5 mins): The pupils work in pairs to discuss one of the three instruments: what they are for.  Discussion (10 mins): The pupils feed back to the group. Draw up as a group a list of as many technologies as we can think of under the categories of diagnosis, surgery, and treatment.  10 mins: Show images/videos on my laptop of different medical robots.  Card sort (10 mins): pupils sort cards with different medical technologies written on and/or images into robotic, non-robotic, and sub-categories of diagnosis, surgery and treatment. |
| **How will you check for learning?**   * Name one way in which we can use robots in medicine. * Is this an invasive or non-invasive method? * Able to correctly determine whether a method is robotic or non-robotic. |
| **What assignment(s) will you set?**  Read a paper on automated classification of skin cancer:   * <http://www.nature.com/nature/journal/v542/n7639/full/nature21056.html>   Write a list of questions / things that you don’t understand. |
| **Glossary of key terms**  Robot: a machine capable of carrying out a complex series of actions automatically, especially one programmable by a computer.  Diagnosis: (1) The process of determining the nature of a disease or disorder; (2) The decision reached from the above process.  Invasive: A medical procedure, such as surgery, that penetrates or breaks the skin.  Non-invasive: A medical procedure that does not penetrate or break the skin, and is typically harmless to the patient, with minimal or no side effects. |

# Tutorial 2 (60 minutes)

*Read steps 4-8 on pages 8-15 in the Course Design Handbook and complete your tutorial plans.*

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| **What is the purpose of the tutorial?**  To discuss different types of diagnosis, and the ethical implications of automated diagnosis.  To understand the principle of deep neural networks for disease classification.  To develop skills for literature review. |
| **What content will the pupils be studying?**  Different types of diagnosis: clinical signs and symptoms, imaging, histopathology. |
| **What skills will the pupils be demonstrating?**  Contextualisation: how do robotic methods fit into the wider context of disease diagnosis?  Application: based on the discussion from the last tutorial, are these methods robotic or non-robotic, invasive or non-invasive? |
| **What are the key questions?**   * What are the advantages and disadvantages of different diagnostic techniques? * Are some methods more suitable for certain diseases? |
| **What resources and activities will you use?**  I will bring microscopic slides of tissue samples to demonstrate histopathology.  Starter (5 mins): I will put up a number of the questions, one by one, raised by the pupils in the assignment. Each pupil tries to answer the question on a post-it note. They put a red, yellow or green sticker on the post-it note to rate how confident they feel about their answer.  Diagnosis methods (15 mins). Activity (5 mins): in pairs pupils summarise diagnosis methods in 5 keywords.  Diagnosis robotics (20 mins). Activity (5 mins): pupils write down three statements about diagnosis, at least one of which is incorrect. The statements are read out and the rest of the pupils find the fiction.  Plenary (5 mins): repeat the starter. |
| **How will you check for learning?**  I will check the post-it notes. |
| **What assignment(s) will you set?**  Find at least five images related to surgery   * Does the image relate to a particular disease or part of body? * What are the limitations associated with this surgical method? |
| **Glossary of key terms**  Histopathology: the microscopic examination of tissues in order to identify the manifestations of disease. |

# Tutorial 3 (60 minutes)

*Read steps 4-8 on pages 8-15 in the Course Design Handbook and complete your tutorial plans.*

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| **What is the purpose of the tutorial?**  To discuss different types of surgery and the relevance to difference diseases and parts of body.  To introduce the DaVinci hand as an example of a surgical robot. |
| **What content will the pupils be studying?**  The images found for the previous assignment. |
| **What skills will the pupils be demonstrating?**  Critical thinking: what are the drawbacks of different surgical approaches?  Contextualisation: how do surgical robots relate to the AI diagnosis methods discussed in the previous tutorial? |
| **What are the key questions?**   * How was the DaVinci hand developed? * When is it used, and what are the limitations? |
| **What resources and activities will you use?**  I will explain each technique with the aid of diagrams. For ultrasound imaging, I’ll bring along a laptop ultrasound scanner and a handheld Doppler ultrasound probe to demonstrate.  Starter (2 mins): Pupils write a list of questions about robots that they would like to be answered.  Role play (5 mins). In pairs the pupils discuss the interviews they carried out for the homework assignment. Each pair then chooses one of the cases, and plays interviewer/interviewee to the rest of the group.  Discussion of the images found in the assignment (15 mins).  Discussion of the DaVinci hand (20 mins).  Plenary (8 mins). I will read out some of the questions written at the beginning and we will answer them as a group. |
| **How will you check for learning?**  At the end each pupil will be asked to say something they have learnt from the tutorial and something they are still unsure of. |
| **What assignment(s) will you set?**  Interview someone who has had cancer treatment, or who is currently undergoing treatment. If you don’t know anyone, you can imagine an interview with a fictitious character.   * What type of cancer did they have? * What treatment(s) did they receive? * Were there any side effects? |
| **Glossary of key terms** |

**Tutorial 4 (60 minutes)**

*Read steps 4-8 on pages 8-15 in the Course Design Handbook and complete your tutorial plans.*

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| **What is the purpose of the tutorial?**  To discuss different types of cancer treatment.  To learn about the CyberKnife robot used for radiotherapy. |
| **What content will the pupils be studying?**  Images of cancers and radiotherapy treatment plans. |
| **What skills will the pupils be demonstrating?**  Critical thinking and evaluation of different medical robots. |
| **What are the key questions?**   * What is the advantage of the CyberKnife over conventional cancer treatments? |
| **What resources and activities will you use?**  Starter (5 mins): Hot seating. One pupil is chosen and we all ask the pupil questions about the medical robots discussed in the previous tutorials.  Role play (5 mins). In pairs the pupils discuss the interviews they carried out for the homework assignment. Each pair then chooses one of the cases, and plays interviewer/interviewee to the rest of the group.  Discussion (15 mins):  Discussion (15 mins):. |
| **How will you check for learning?**  Splat (5 mins): ten key words written on the board. Two pupils stand in front of the board. The tutor reads out the definition and the first pupil to tap the correct word with their hand wins. |
| **What assignment(s) will you set?** ***You should be setting a full draft or section of the final assignment***  Write 900 words discussing robotic techniques currently used in diagnosis, surgery and treatment. |
| **Glossary of key terms**  Ionising radiation:  Non-ionising radiation:  Radiation dose:  Fiducial marker: |

# Tutorial 5 (60 minutes)

*Read steps 4-8 on pages 8-15 in the Course Design Handbook and complete your tutorial plans.*

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| **What is the purpose of the tutorial?**  To discuss robots used for rehabilitation, with reference to stroke as an example.  To give feedback on the draft assignments submitted.  To explain the process of a good write-up.  To examine existing publications expressing a current opinion on the future direction of a field. |
| **What content will the pupils be studying?**  A case study of a stroke rehabilitation patient.  The essays written for the previous assignment. |
| **What skills will the pupils be demonstrating?**  Logical reasoning in order to arrive at a conclusion for the future of medical robotics. |
| **What are the key questions?**   * How can we use the knowledge acquired throughout the tutorials about different medical robots in order to hypothesise about the future of medical robotics? * What are the difficult questions and ethical implications that we need to consider? |
| **What resources and activities will you use?**  Starter (5 mins): Peer assessment of homework. Pupils assess the essays produced for the previous assignment and give feedback.  Case studies (20 mins): practise working through the flow diagrams using different case studies.  Discussion (20 mins): What makes a good write-up? |
| **How will you check for learning?**  10 keywords (5 mins): Pupils write down ten keywords on pieces of paper. Pupils choose two of these words and describe the relationship between them.  A-Z of the course (5 mins): pupils try to write keywords for medical robotics using all the letters in the alphabet. |
| **What assignment(s) will you set?** ***You should be setting the final assignment***  The task is to write a “current opinion” article as an expert medical professional to a Nature journal hypothesising on whether our future medical professionals will be robots.  The assignment will take a two-part format, but may be combined into a single essay:   * An evaluation of at least 4 types of medical robots currently employed in one or more of diagnosis, surgery, cancer treatment, and rehabilitation (1200 words). * A reasoned hypothesis of the future status of robotics in medicine and the ethical implications (800). |
| **Glossary of key terms**  Rehabilitation |

# Tutorial 6 (40 minutes)

*Here is a suggested plan for your final tutorial which will take place at the graduation trip.*

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| **What is the purpose of the tutorial?**   * *To feedback to pupils on their assignments* * *To share best examples of academic work among their peers* * *To reflect on skills learned on the programme with a view to encouraging resilience* * *To complete self-evaluation form* |
| **What content will the pupils be studying?**   * *Comments and feedback from tutor* * *Extracts of excellent essays from peers in tutorial groups* * *Course handbook / extracts of subject-specific material* * *Questions on the Self-Evaluation Form (The Brilliant Club)* |
| **What skills will the pupils be demonstrating?**   * *Self-reflection* * *Close reading and analysis of their own work and reviewing the work of their peers* * *Prioritising areas for improvement* |
| **What are the key questions?**   * *What strengths have I demonstrated in my work and what areas for development are there left for me to address?* * *What next steps do I need to take to improve my academic output?* |
| **What resources and activities will you use?**   * 1. *Greet the students and catch up with how they are doing.*   2. *Take some time to explain the grading system and my approach to marking the assignments.*   *10-15 Share feedback forms with pupils and ask them to re-read their assignments in the light of the comments that I have given. Take the opportunity to clarify any comments with individual students and explain the marking.*  *15-25 Share worksheet with outstanding extracts from students’ essays (+my comments). Close-read the extracts, identifying what makes the extracts so good. Pupils write down notes on what they have done well and what they need to improve.*  *25-30 Complete SEF as per instructions on sheet*  *30-40 Have a general discussion about their studies and subject interests, how their work has improved over the course of the programme and their aspirations for the future.* |
| **How will you check for learning?**   * *Check written output* * *Share back contributions with the group and ask follow-up questions* * *Explain feedback and ask pupils to identify next steps for improvement* |