

Introduction

This document provides all the necessary information about the group assignment for Internet Technology for CreaTe. Please read the document carefully before you get started. The document covers the following topics:

- The requirements for group composition, how to form groups, how to register your group and the rules of play.
- A discussion of the various options for performing this assignment.
- A schedule to help guide you through the assignment and to complete it on time.
- A description of the deliverables we expect you to hand in at the end of the course.
- The rubric for the assignment.

If you have any questions about the assignment, please come forward during the tutorials, if you have urgent questions outside of tutorial hours, please contact the TAs and teaching staff via Canvas or email (please make sure to copy in all relevant TAs and staff members).

Group requirements, group formation, and rules of play

Group requirements and formation

You are expected to form **groups of four students** during the week 3 tutorial (or earlier). If this turns out to be challenging, please come forward during the week 3 tutorial so we can help you find others to collaborate with. If necessary, we also allow smaller groups to be formed, but this is an exception (in case, e.g., the number of enrolled students is not a multiple of 4). It is a **hard requirement** that you **form your group by the end of week 3** of the course, if for some reason you are unable to join a group, contact us immediately.

Once you have formed a group, **please register your group in Canvas** in the “People” tab under a group labelled “[IT] Group Assignment” (see also Figure 1). This will also give you a group number. Please include this group number and all of your names and student numbers in all deliverables that you hand in at the end of the course.

You will work with the same group for the remainder of the course, in case there are issues in collaboration please read on for more information about the rules of play.

Rules of play

We expect you and your group to work as a team. That means that every member contributes, and that you communicate about the division of work. If, for some reason, you are unavailable during a tutorial or at any other moment your group has planned to work on the assignment, you are responsible for notifying the group about this as soon as possible and you are expected to make up for time lost. The system with yellow, red and green cards as outlined in the module manual also applies to this group assignment, consult the module manual for more

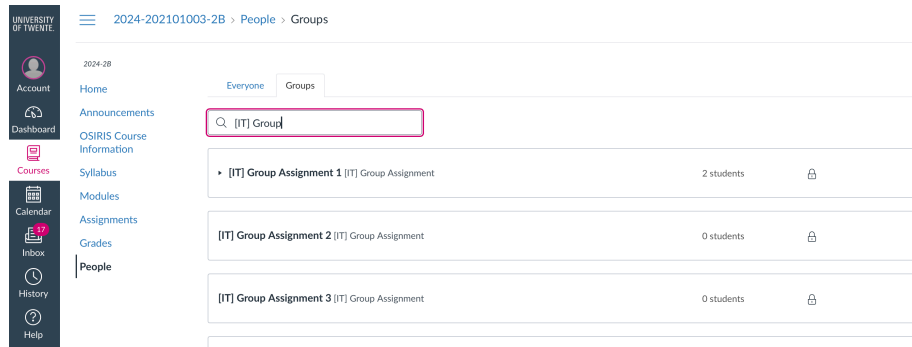


Figure 1: How to register your group in Canvas

information. Note, that as outlined in the module manual, we expect you to inform us as soon as you decide to give a card (regardless of whether this is positive or negative) and to motivate your decision as a group.

In terms of workload we expect you to be able to complete the group assignment by attending the four tutorials allocated for the group assignment, which will also give you the opportunity to solicit feedback from the TAs and teachers, and by scheduling some additional hours to work on the assignment as a team. As a **rule of thumb** you should **spend no more than 4 additional hours per week on the assignment**.

If you submit all required deliverables and your artefact qualifies at least as a minimum viable product according to the rubric provided at the end of this document, you will receive a passing grade.

Assignment options

Goal of this assignment

The goal of this group assignment is that you get experience with real-world data from (vastly) distributed systems and networks. You will gain insight into the relationship between the network technology and how data can be received and processed for an application. Your focus during the assignment should therefore be on the information about the network aspects of the data, rather than the content of the data, although you can – of course – draw inferences between the two.

For the assignment, we provide two options (explained in more detail below). In both cases we provide:

- A data feed over a websocket¹ that delivers information about single data packets in JSON format². We have chosen both technologies because they are easy to process with different tools, such as Python, JavaScript and other programming languages that have built-in support for both.
- Metadata about each packet, such as sender address, packet size, signal strength, etc. In case of the first option (ADS-B) we also decode and provide packet contents for you.
- Sample Python notebooks that demonstrate how you can access the data stream for both options.

¹<https://en.wikipedia.org/wiki/WebSocket>

²<https://en.wikipedia.org/wiki/JSON>

Option A: ADS-B

The first type of data we provide is ADS-B data from two receivers that we have set up on the fifth floor of the Zilverling building on campus. ADS-B stands for “Automatic Dependent Surveillance-Broadcast” and is used by aircraft to transmit information about their position, speed, altitude, identity, etc. ADS-B is a packet format that is broadcast by transmitters built into aircraft on a fixed frequency (1,090 MHz). You may be familiar with, e.g., websites such as FlightRadar24, which show the positions of aircraft worldwide. These websites make use of crowdsourced ADS-B receivers to monitor broadcasts by aircraft. Our setup is a poor-man’s version of this, with only two receivers that “look” in different directions from a high position.

You can read more about ADS-B in this short book by Junzi Sun from TU Delft’s Faculty of Aerospace Engineering. This provides you a lot of background information on how ADS-B works, what is important to know is that all of the decoding of messages to determine, e.g., latitude, longitude and altitude is already done by us, so you receive decoded information in the data stream. Nevertheless, the book helps you understand what different message types exist and why you often need to combine data from multiple messages to get all information for a single aircraft.

If you choose this option, you can start from the example Python Jupyter notebook on Canvas labelled “Example notebook for ADS-B”.

Option B: LoRaWAN

The second type of data we provide is a feed of all messages received by LoRaWAN gateways operated by the University of Twente. Our university makes extensive use of LoRa-based sensors for, e.g., air quality, room occupancy, and other types of sensing. These sensors are placed all over our campus, and there are also sensors in other locations, e.g., in the city centre of Enschede. The university makes use of gateways placed in different locations, both inside buildings as well as outdoors. The data feed is an aggregation of all messages received by all gateways, and the data is annotated with information about the sensor that is sending the data, if this is a known sensor (i.e., this is a sensor belonging to the UT). Note: as you learned in the lecture, LoRa uses unlicensed radio spectrum, so the UT’s gateways also receive (many) messages from sensors that do not belong to the university.

In addition to providing you with the data stream, we also provide you with two CSV files that contain tables with the locations (latitude/longitude/altitude) of the gateways and of the sensors. Latitude and longitude are specified in degrees, altitude is given in metres.

If you choose this option, you can start from the example Python Jupyter notebook on Canvas labelled “Example notebook for LoRaWAN”. Gateways locations are in `gateway_locations.csv` and the locations of the sensors are in `sensor_locations.csv`. Both files can be downloaded from Canvas, note: these files only contain information on *known* sensors, remember that you may also see messages from sensors that do not belong to the university.

Schedule

There are four tutorials scheduled for the group assignment. For each tutorial we suggest what you should work on with your group. You are, of course, allowed to deviate from these suggestions, but following them may help you complete the assignment on time.

The suggested topics are:

- **Tutorial 1** – we suggest that you spend your time picking one of the two assignment options, that you familiarise yourself with the examples provided and that you brainstorm on ideas what your group is going to do with the option you picked. Make use of the opportunity to get feedback from the TAs and teaching staff on your ideas. Also, do not forget to define the scope of your idea. Creativity is great, but sometimes your ambitions exceed the time that you have. Take some time to do a MoSCoW analysis³ and define what your minimum viable product is, and which are options that you can add if you have the time.
- **Tutorial 2** – now that you have defined what you are going to do, it is good to spend some time working on how you collect and store data from the source you selected for your assignment. Do you actually need to store data? Where do you store that data? How do you store that data?
- **Tutorial 3** – once you have your data ready, the next step is to work on visualisations. Let your creativity roam free, and, equally importantly, apply some of the things you learned during Module 8 in practice. You are free to pick a visualisation, so a website, a poster, or graphs that give insights into the data are all options.
- **Tutorial 4** – in the last tutorial before the demo session it is time to wrap up, so prepare your demo or create your poster to show off your work in the final session.
- **Demo/poster session** – we will gather with all groups, including the groups from CreaTe@VU, to show each other what we have done. The teaching team will visit each group to look at your demo(s) and/or poster and to ask about your project.

Please consult the course manual for an up-to-date schedule for the tutorials.

Deliverables

At the end of the group assignment, we ask you to submit the following deliverables:

- **Source code** – all source code of any scripts or applications that you have made for your project. Please collect all of these in a ZIP archive and upload this to Canvas (a submission link will be provided). If you make use of a version control platform, such as Github, we appreciate a link to the repository (this is optional).
- **Project description** – a concise description (keep it to a few pages) of what you have done, including at least the following points:
 - A short description of *what* your project does.
 - A short motivation *why* you picked this idea.
 - A short discussion of *what* you have *learned* during the assignment.
 - A short *reflection on how you worked as a group*; what went well, what could be improved, ...

Again, **keep it concise**, we do **not** expect you to submit project reports of **more than 10 pages**. We ask you to upload a PDF document with your project description on Canvas (a submission link will be provided).

³https://en.wikipedia.org/wiki/MoSCoW_method.

- **Demo or poster** – at your choice, you can either create a poster (we will provide instructions on how to present a poster during the final session), or you can create an online demo. The teaching team will come and visit your group during the final session. If you opt for a poster, please upload a PDF in Canvas (a submission link will be provided). If you instead opt for a demo, please include all relevant source code in the ZIP archive with your sources, bonus points can be earned if we can independently run the demo based on the materials you provide.

Rubric

While assessing the deliverables, we take the following things into account:

- The clarity of the motivation for what you chose to do with the data source you selected.
- How you used information about the network technology (signal strength, spreading factor, other parameters) for the assignment option your group chose.
- How you incorporated other information about the transmissions you received from the data source (e.g., line of sight blocking, interference, reception on multiple antennas, ...).
- Your creativity in visualising insights from the data.
- The quality of your demo or poster.
- Your reflection on how you worked as a group.
- We award extra credit for creatively combining the data that we provide to you with data from external sources.