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Emerging Technologies I

MIS 284N | Fall 2019

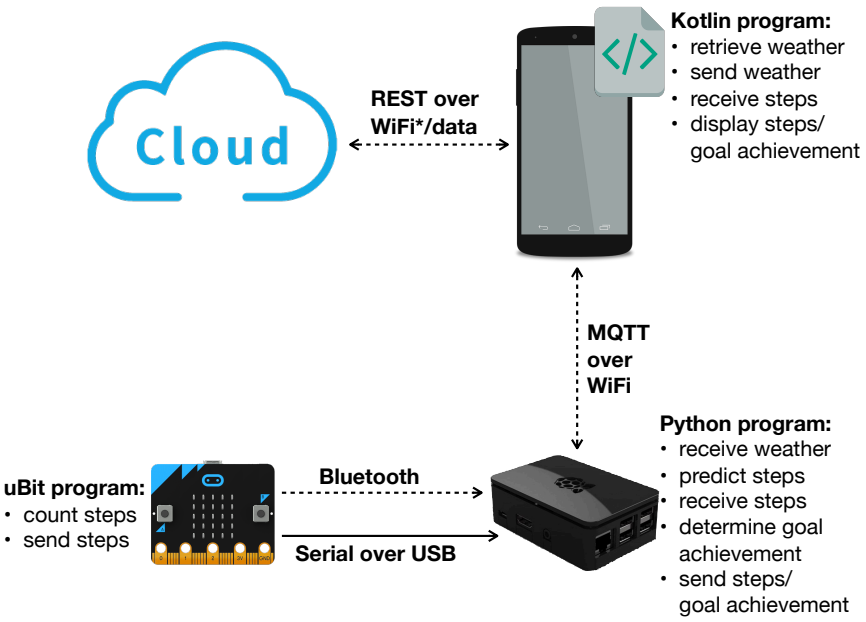
Project Description

This document serves as an overview of the Emerging Technologies project. Additional details for each step will be provided in lecture on Thursdays during the regular course meeting time.

In addition to the project milestones described below, Homework 0 is also related to the project. Between the start of the class and November 18, we'll each contribute our daily step information so we can build a model to be used later. We will collect that via an online spreadsheet. You can use any mechanism to collect the information (e.g., a fitbit, a phone app, etc.).

Project Milestones

An overview figure of the entire project is given below. Each milestone of the project will walk you through a component of the project.



Milestone 1: Program the microbit to count steps. The microbit is a *very* simple device (it's actually targeted to kids). For our project, it's a stand-in for a very simple off-the-shelf IoT device over which you may have very little control. For our first milestone, we'll get familiar with the microbit and write a very simple pedometer program based on a provided template.

Milestone 2: In the second step, we'll (1) set up a Raspberry Pi device and (2) connect the microbit step counter to a python program on the Raspberry Pi. We'll use both a serial connection via USB and a Bluetooth connection to get data from the microbit to the Raspberry Pi. The Raspberry Pi will also serve a secondary purpose for the project: it will actually be a WiFi access point that the Android device can eventually connect to. You can also use this WiFi connection to run VNC from your laptop computer to program the Raspberry Pi without any need for peripherals (e.g., keyboard, mouse, monitor) for the Raspberry Pi.

Milestone 3: Next, we will enable the data to be sent from the Raspberry Pi to an Android device using a protocol called MQTT. This publish-subscribe protocol will run over a WiFi connection from the Raspberry Pi to the Android device. The Raspberry Pi will host the MQTT *broker*, and both the Raspberry Pi and Android devices will host MQTT *clients*. The Raspberry Pi will use a python MQTT library; the Android app will be written in Kotlin using a Java MQTT library. A template Android app will be provided that you can start from. In this milestone, the Raspberry Pi will send step data to the Android device; for now, the Android device should just send back some dummy data to the Raspberry Pi.

Milestone 4: The fourth milestone will focus more on the Android device. We will program to a RESTful web interface (Open Weather Map) to retrieve and process weather data, and we will update the Android app to pass pieces of this retrieved weather data on to the Raspberry Pi along the MQTT connection we already have working.

Milestone 5: The fifth milestone is where we see everything come together for the first time. We will provide a trained model that will predict a "goal" step count based on the day's weather. This model will run on the Raspberry Pi, using the weather information retrieved from the Android device via MQTT. Instead of the Raspberry Pi sending back the (private!) step count to the Android device, it will now just send back an indicator as to whether the goal was achieved or not. [Note, there is a connectivity challenge here. To retrieve weather data, the Android device needs to be connected to the Internet, e.g., via the utexas network. However, to send data to and from the Raspberry Pi, the Android device will have to be connected to the Raspberry Pi's network. We'll have to manage this explicitly, unfortunately.]

Milestone 6: Next, we'll show how we can continue to update our learned model on the Raspberry Pi based on the samples we retrieve on a daily basis. You'll be able to take a general purpose model and "personalize" it to your specific behaviors.

Milestone 7: Whatever you want! Use something else on the microbit? Do something else in the Android app? Connect in a new RESTful API? Basically, you'll propose an additional feature and implement it.

Project Logistics

Projects will be done in teams of three. Students can choose their own teams for the project; each member of the team will receive the same grade on all portions of the project.

The project will require the use of three devices: a BBC microbit microcontroller, a Raspberry Pi, and an Android smartphone. All devices can be provided for use for the project. A course grade of Incomplete will be given to any pair that fails to return the devices; the grade will remain Incomplete until the devices are returned. Alternatively, students can use their own devices if they have them.

The project has seven milestones. Each milestone is equally valued at 10% of your final course grade. Each milestone will be introduced in class on Thursday (with the exception of Week 6) with the expectation that the final product will be demoed to the TA on the following Wednesday in office hours. We will often have time to work on the project during class on Thursday.