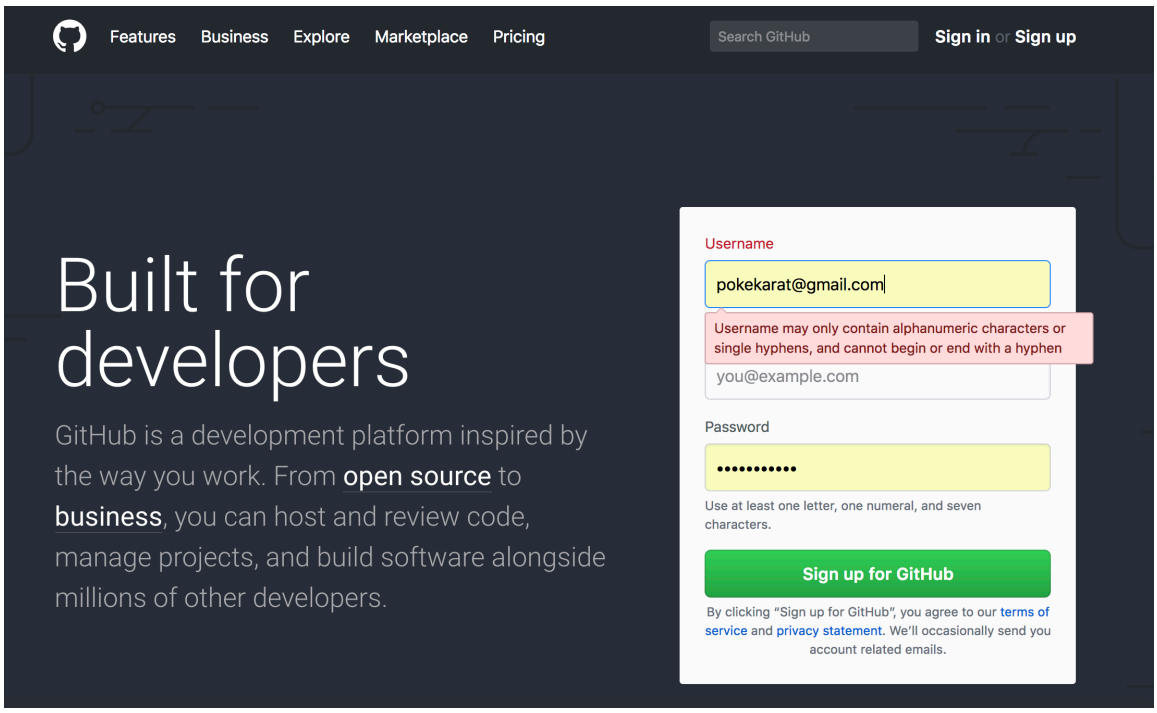
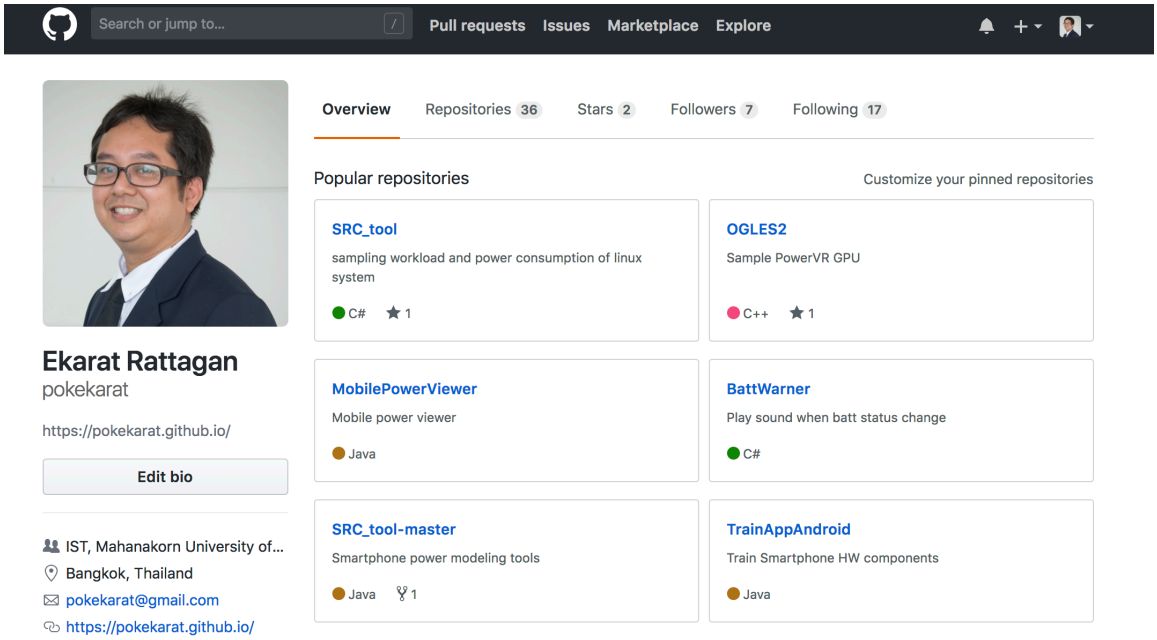
# Lab1

1. Outline
- Set up Git
- Exercises

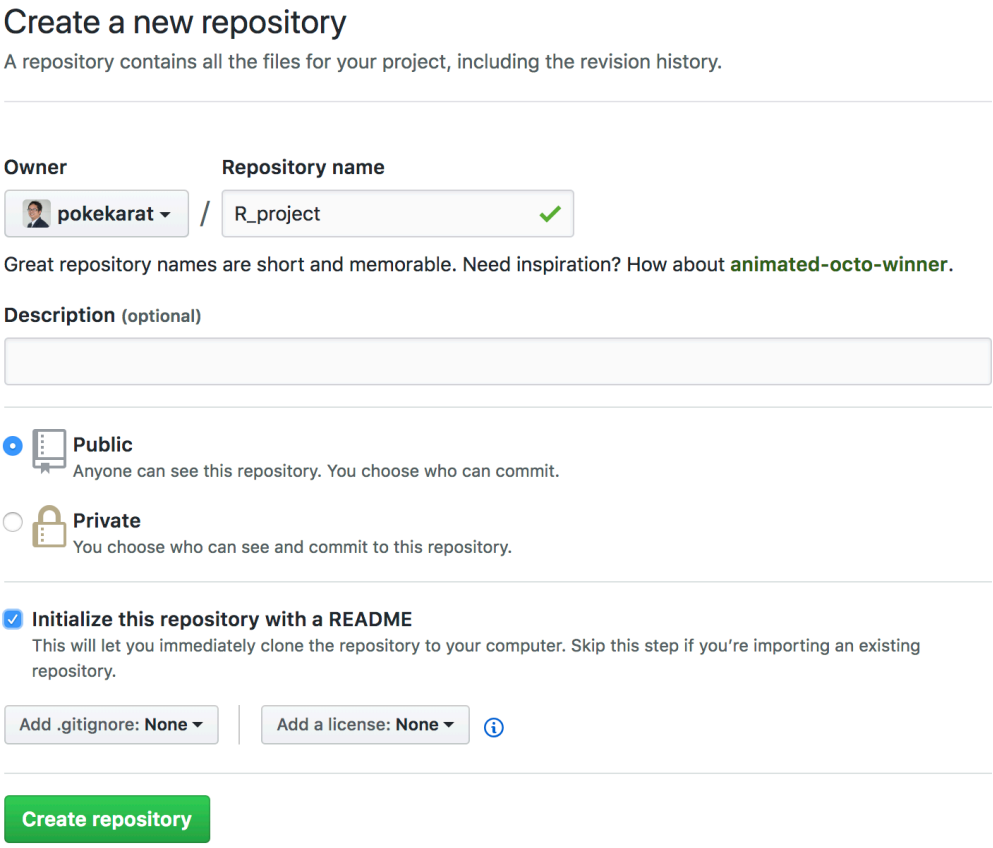
2. Sign up your account on Github: https://github.com/

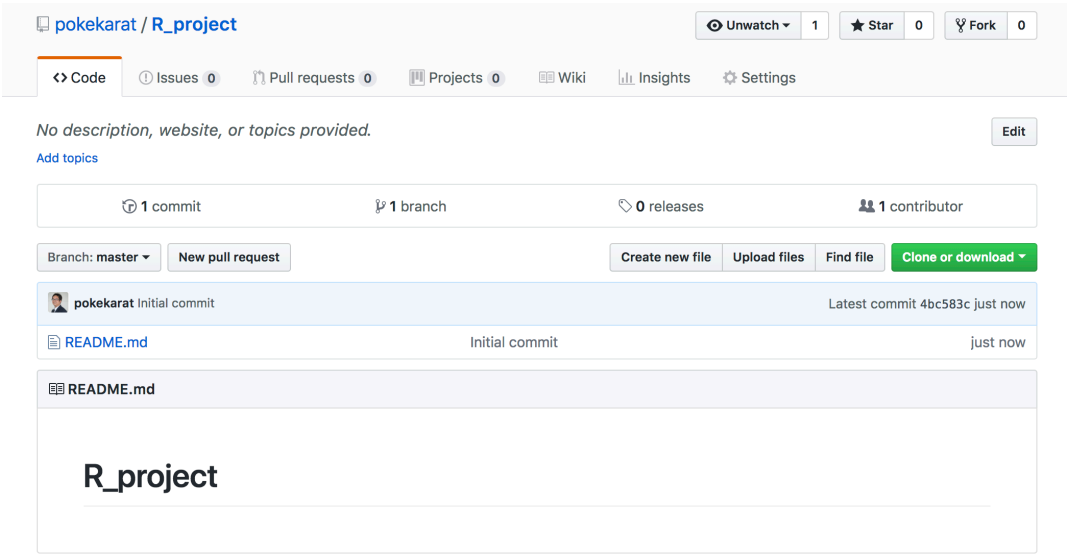



3. Add your profiles

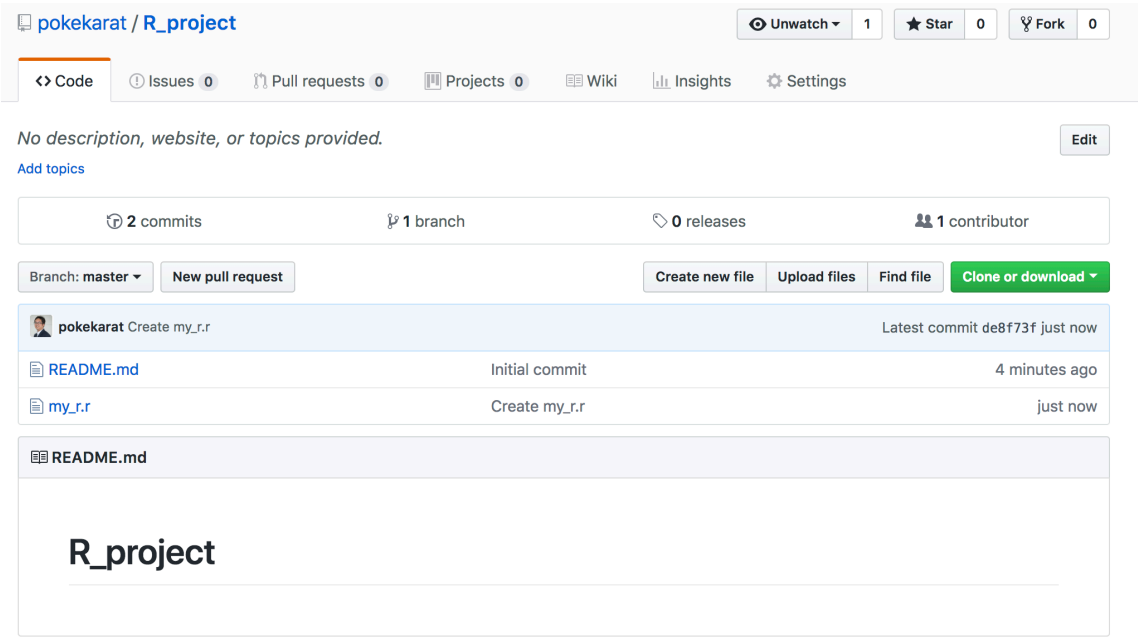


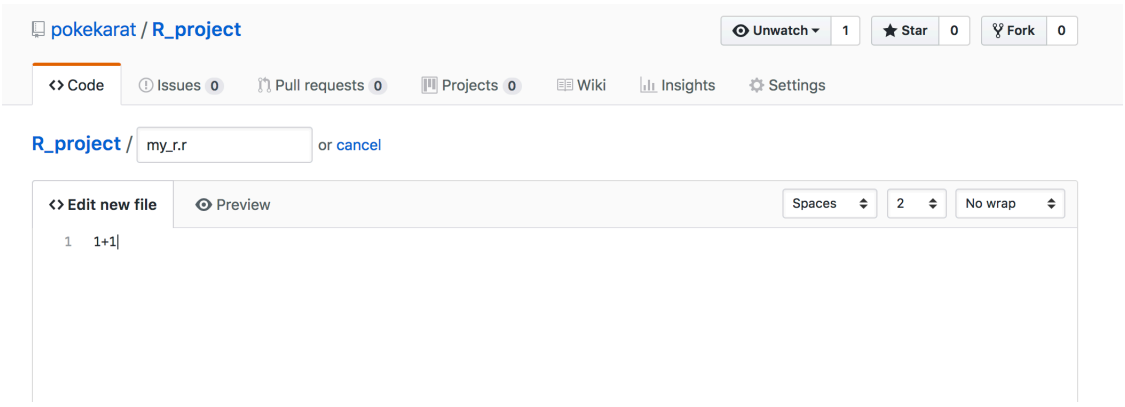
4. Add a new repository, R_project, as a public folder and initialize README file

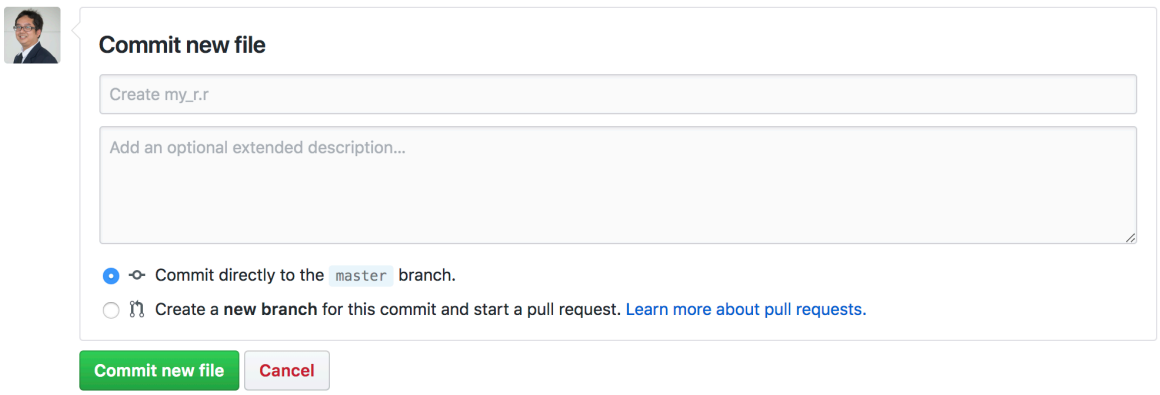


5. Create my_r.r file inside R_project, and commit new file

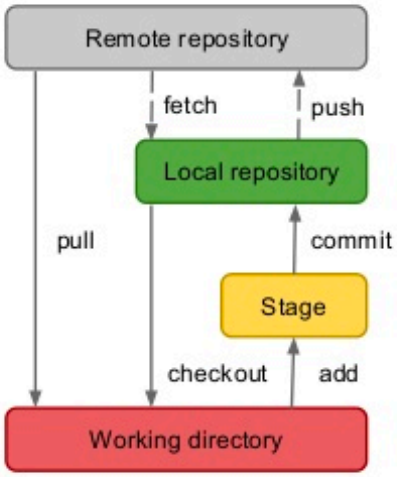


6. Git workflow

# Understanding of workflow




- Obtain a repository
  - *git init* or *git clone*
- Make some changes
- Stage your changes
  - *git add*
- Commit changes to the local repository
  - *git commit -m "My message"*
- Push changes to remote
  - *git push remotename remotebranch*

## Exercises

**1.** Create the vectors:

**(a)** $(1, 2, 3, \ldots, 19, 20)$

**(b)** $(20, 19, \ldots, 2, 1)$

**(c)** $(1, 2, 3, \ldots, 19, 20, 19, 18, \ldots, 2, 1)$

**(d)** $(4, 6, 3)$ and assign it to the name `tmp`.

For parts (e), (f) and (g) look at the help for the function `rep`.

**(e)** $(4, 6, 3, \ 4, 6, 3, \ldots, 4, 6, 3)$ where there are 10 occurrences of 4.

**(f)** $(4, 6, 3, \ 4, 6, 3, \ldots, 4, 6, 3, 4)$ where there are 11 occurrences of 4, 10 occurrences of 6 and 10 occurrences of 3.

**(g)** $(4, 4, \ldots, 4, \ 6, 6, \ldots, 6, \ 3, 3, \ldots, 3)$ where there are 10 occurrences of 4, 20 occurrences of 6 and 30 occurrences of 3.

**4.** Calculate the following:

**(a)** $\sum_{i=10}^{100} \left(i^3 + 4i^2\right)$.

**(b)** $\sum_{i=1}^{25} \left(\frac{2^i}{i} + \frac{3^i}{i^2}\right)$

**6.** Execute the following lines which create two vectors of random integers which are chosen with replacement from the integers 0, 1, ..., 999. Both vectors have length 250.

```
set.seed(50)
xVec <- sample(0:999, 250, replace=T)
yVec <- sample(0:999, 250, replace=T)
```

Suppose $\mathbf{x} = (x_1, x_2, \ldots, x_n)$ denotes the vector `xVec` and $\mathbf{y} = (y_1, y_2, \ldots, y_n)$ denotes the vector `yVec`.

**(a)** Create the vector $(y_2 - x_1, \ldots, y_n - x_{n-1})$.

**(b)** Create the vector $\left(\frac{\sin(y_1)}{\cos(x_2)}, \frac{\sin(y_2)}{\cos(x_3)}, \ldots, \frac{\sin(y_{n-1})}{\cos(x_n)}\right)$.

**(c)** Create the vector $(x_1 + 2x_2 - x_3, x_2 + 2x_3 - x_4, \ldots, x_{n-2} + 2x_{n-1} - x_n)$.

**(d)** Calculate $\sum_{i=1}^{n-1} \frac{e^{-x_{i+1}}}{x_i + 10}$.

## 7. Matrix

7.1 Create the following matrix $\mathbf{B}$ with 15 rows:

$$\mathbf{B} = \begin{bmatrix} 10 & -10 & 10 \\ 10 & -10 & 10 \\ \cdots & \cdots & \cdots \\ 10 & -10 & 10 \end{bmatrix}$$

Calculate the $3 \times 3$ matrix $\mathbf{B}^T\mathbf{B}$. (Look at the help for `crossprod`.)

7.2 Write a function which takes a single argument which is a matrix. The function should return a matrix which is the same as the function argument but every odd number is doubled.

Hence the result of using the function on the matrix

$$\begin{bmatrix} 1 & 1 & 3 \\ 5 & 2 & 6 \\ -2 & -1 & -3 \end{bmatrix}$$

should be:

$$\begin{bmatrix} 2 & 2 & 6 \\ 10 & 2 & 6 \\ -2 & -2 & -6 \end{bmatrix}$$

## 8. Functions

**(a)** Write functions `tmpFn1` and `tmpFn2` such that if `xVec` is the vector $(x_1, x_2, \ldots, x_n)$, then `tmpFn1(xVec)` returns the vector $\left(x_1, x_2^2, \ldots, x_n^n\right)$ and `tmpFn2(xVec)` returns the vector $\left(x_1, \frac{x_2^2}{2}, \ldots, \frac{x_n^n}{n}\right)$.

**(b)** Now write a function `tmpFn3` which takes 2 arguments `x` and `n` where `x` is a single number and `n` is a strictly positive integer. The function should return the value of

$$1 + \frac{x}{1} + \frac{x^2}{2} + \frac{x^3}{3} + \cdots + \frac{x^n}{n}$$

Write a function `tmpFn(xVec)` such that if `xVec` is the vector $\mathbf{x} = (x_1, \ldots, x_n)$ then `tmpFn(xVec)` returns the vector of moving averages:

$$\frac{x_1 + x_2 + x_3}{3}, \quad \frac{x_2 + x_3 + x_4}{3}, \quad \ldots, \quad \frac{x_{n-2} + x_{n-1} + x_n}{3}$$

Try out your function; for example, try `tmpFn( c(1:5,6:1) )`.