Homework #3,   2021/3/29 11:59 pm

1. (21 %) 請評估下列 MATLAB 的執行結果 (如為邏輯結果，回答真/偽；如為數值，回答它的值)

   (a) 5 – 3 >= -2 + 4   →(5-3)>=(-2+4)   →2>=2   →true

   (b) 5 – (3 >= -2) + 4   →5-(true)+4   →5-1+4   →8

   (c) xor (15 – pi < 15, pi > 3)   →xor(true,true)   →false

   (d) true > false   →1>0   →true

   (e) ~ ~ (35 / 17) == (35 / 17)   →true==(35/7)   →false

   (f)   (3 / 2 == 1) == (7 <= 8) →false==true   →false

   (g) 17.5 && (3.3 > 2.0)   →17.5&&true   →true&&true →true

2. (30 %) 請以 for 迴圈、向量優化與多核心(2 核心)方法求下列級數和，並用 tic 與 toc 指令比較三種方法的計算所需時間 (提示: Matlab 的求和函數 sum 為向量優化函數)：

(1) $-1^2+2^2-3^2+4^2-\ldots\ldots-5049^2+5050^2=?$

hw2_1.m

```matlab
for process = 1:2
    parpool('local',process);
    tic
    SUM = 0;
    flag = -1;
    for index = 1:5050
        SUM = SUM + flag*index^2;
        flag = flag*-1;
    end
    fprintf("\titeration:%d\t\t",SUM)
    toc
    clear
    tic
    SUM = sum((2:2:5050).^2)-sum((1:2:5050).^2);
    fprintf("\tvectorization:%d\t",SUM)
    toc
    clear
    delete(gcp('nocreate'))
end
```

Output:

Starting parallel pool (parpool) using the 'local' profile ...

Connected to the parallel pool (number of workers: 1).

    iteration:12753775   Elapsed time is 0.000765 seconds.

    vectorization:12753775 Elapsed time is 0.000472 seconds.

Parallel pool using the 'local' profile is shutting down.

Starting parallel pool (parpool) using the 'local' profile ...

Connected to the parallel pool (number of workers: 2).

    iteration:12753775   Elapsed time is 0.000494 seconds.

    vectorization:12753775 Elapsed time is 0.000199 seconds.

Parallel pool using the 'local' profile is shutting down.

Elapsed time(s)	iteration	vectorization
Single process	0.000765	0.000472
Dual process	0.000494	0.000199

(2) $\cos(-\pi/10) + \cos(-2\pi/10) + L + \cos(-\pi) = ?$

hw2_2.m

```matlab
for process = 1:2
    parpool('local',process);
    tic
    SUM = 0;
    for index = 1:10
        SUM = SUM + cos(index*pi/10);
    end
    fprintf("\titeration:%d\t\t",SUM)
    toc
    clear
    tic
    SUM = sum(cos((1:10).*(pi/10)));
    fprintf("\tvectorization:%d\t",SUM)
    toc
    clear
    delete(gcp('nocreate'))
end
```

Output:

Starting parallel pool (parpool) using the 'local' profile ...

Connected to the parallel pool (number of workers: 1).

    iteration:-1.000000e+00   Elapsed time is 0.001175 seconds.

    vectorization:-1.000000e+00 Elapsed time is 0.000512 seconds.

Parallel pool using the 'local' profile is shutting down.

Starting parallel pool (parpool) using the 'local' profile ...

Connected to the parallel pool (number of workers: 2).

    iteration:-1.000000e+00   Elapsed time is 0.000216 seconds.

    vectorization:-1.000000e+00 Elapsed time is 0.000161 seconds.

Parallel pool using the 'local' profile is shutting down.

Elapsed time(s)	iteration	vectorization
Single process	0.001175	0.000512
Dual process	0.000216	0.000161

(3) 請列出(2)的 MATLAB 效能分析器(MATLAB Profiler)的分析結果

▾ Flame Graph
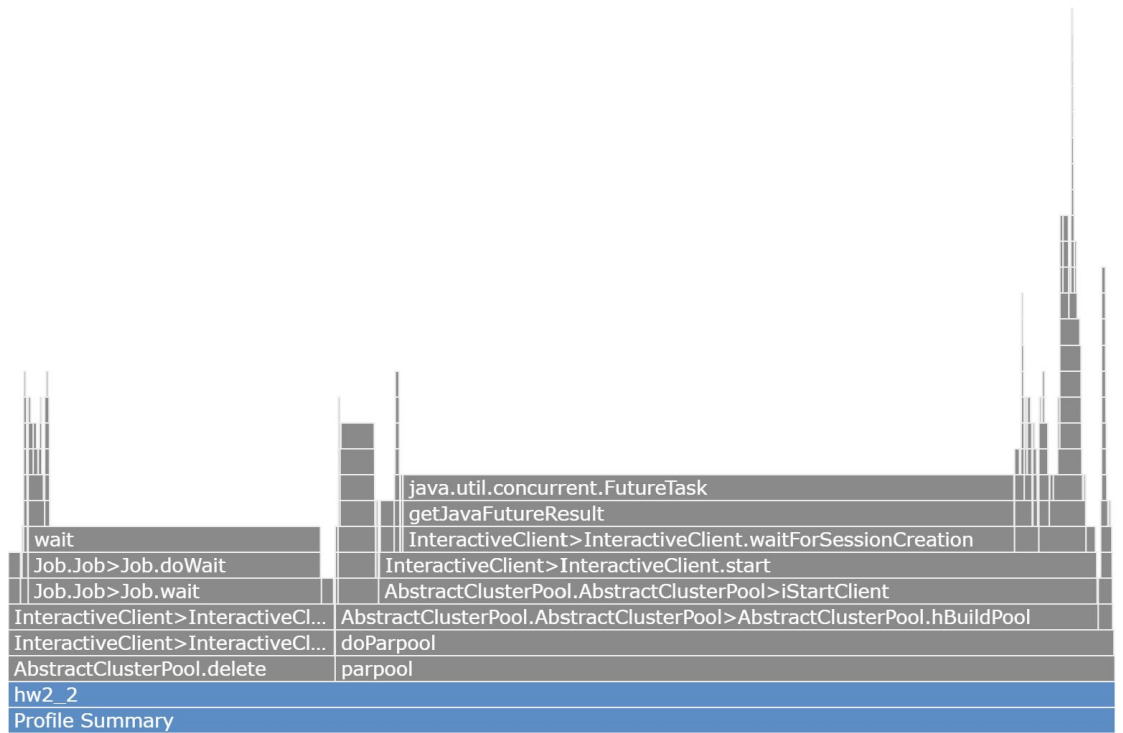
hw2_3.pdf

3. (15 %) 請使用 while 指令求出 1 + 3 + 5 + ... + n > 1000 的最小奇數值 n=?

hw3.m

```
n = 1;
SUM = n;
while SUM<1000
    n = n + 2;
    SUM = SUM + n;
end
fprintf("n=%d\n",n)
```

n=63

4. (20 %) 某實驗顯示水的蒸氣壓 *P* 與溫度 *T* 之關係如下：

$$\ln P = 7.7423 - 1554.16/(219+T),\ 35 \le T \le 55$$
$$\ln P = 7.8097 - 1572.53/(219+T),\ 55 < T \le 75$$
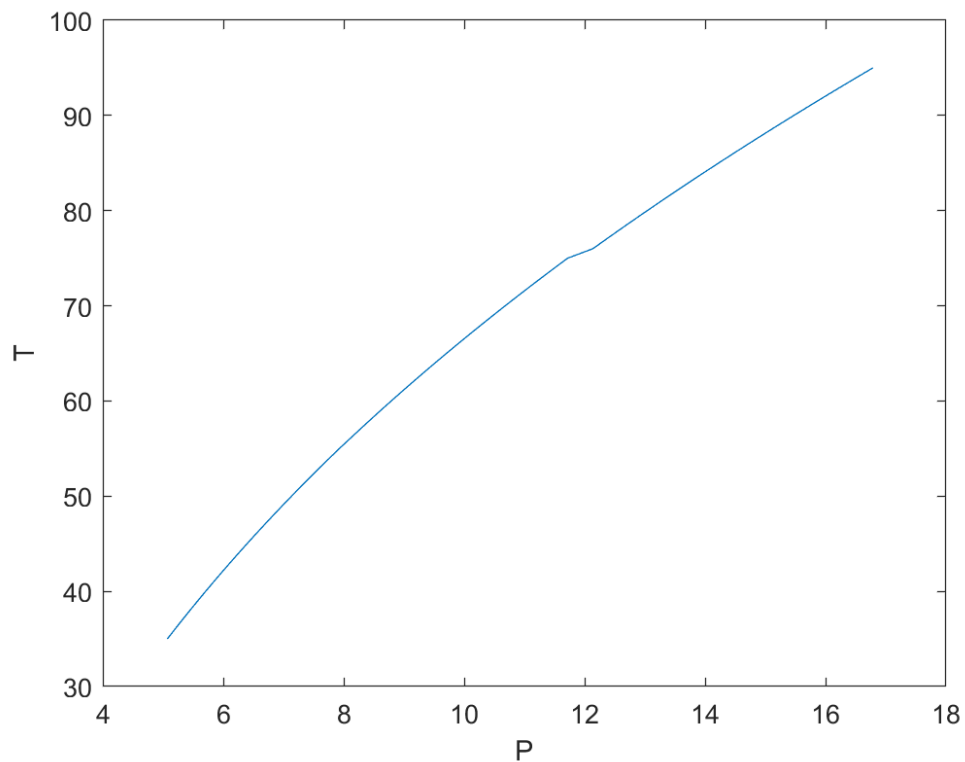$$\ln P = 7.8563 - 1581.22/(219+T),\ 75 < T \le 95$$

請依上列關係式，畫出 *P*　vs. *T* 之圖。
註：溫度 *T* 取 *T*=35: 95，用 if-else-end 結構。

hw4.m

```matlab
T = 35:95;
P = T;
for index = 1:length(T)
    if T(index)<=55
        P(index) = exp(7.7423-1554.16/(219+T(index)));
    elseif T(index)<=75
        P(index) = exp(7.8097-1572.53/(219+T(index)));
    else
        P(index) = exp(7.8563-1581.22/(219+T(index)));
    end
end
plot(P,T); xlabel('P');ylabel('T');
```

5. (14 %)　　某森林中，隔代樹齡分布變化情形可以下式表示：

$$\mathbf{x}(k+1) = \mathbf{A}\mathbf{x}(k)$$

其中，$\mathbf{x}$ 為各樹齡樹木數量所形成之向量，而 $\mathbf{A}$ 為樹齡變化矩陣。已知

$$\mathbf{A} = \begin{bmatrix} 0.1 & 0.2 & 0.3 & 0.4 \\ 0.9 & 0 & 0 & 0 \\ 0 & 0.8 & 0 & 0 \\ 0 & 0 & 0.7 & 0.6 \end{bmatrix}$$

和第 0 代 (剛開始種植時) 各樹齡樹木數量向量為

$$\mathbf{x}(0) = [10000 \quad 0 \quad 0 \quad 0]^T$$

請問在第 3 代時，各樹齡樹木數量 $\mathbf{x}(3) = ?$ 第 10 代時，$\mathbf{x}(10)$ 又是多少？

hw5.m
| ```matlab
A = [0.1 0.2 0.3 0.4; 0.9 0 0 0; 0 0.8 0 0; 0 0 0.7 0.6];
x = [10000 0 0 0]';
for index = 1:10
    x = A*x;
    if (index==3 || index==10)
        fprintf("第%d 代",index);
        fprintf( ['x(%d)= [', repmat('%d ', 1, numel(x)), ']''\n'],index , int64(x));
    end
end
``` |
| Output: |
| 第 3 代 x(3)= [2530 1710 720 5040]'
第 10 代 x(10)= [2576 2320 1862 3242]' |