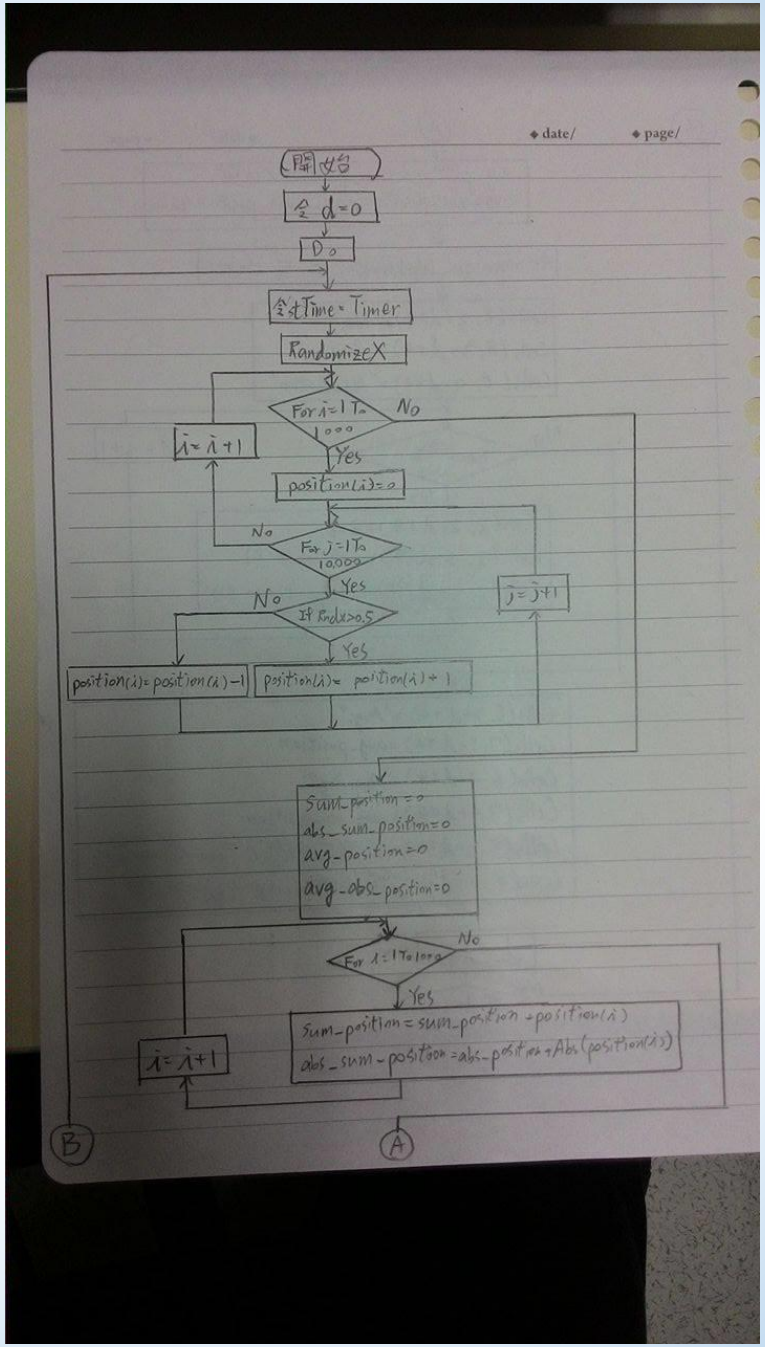
電腦數值模擬導論實習六(a)

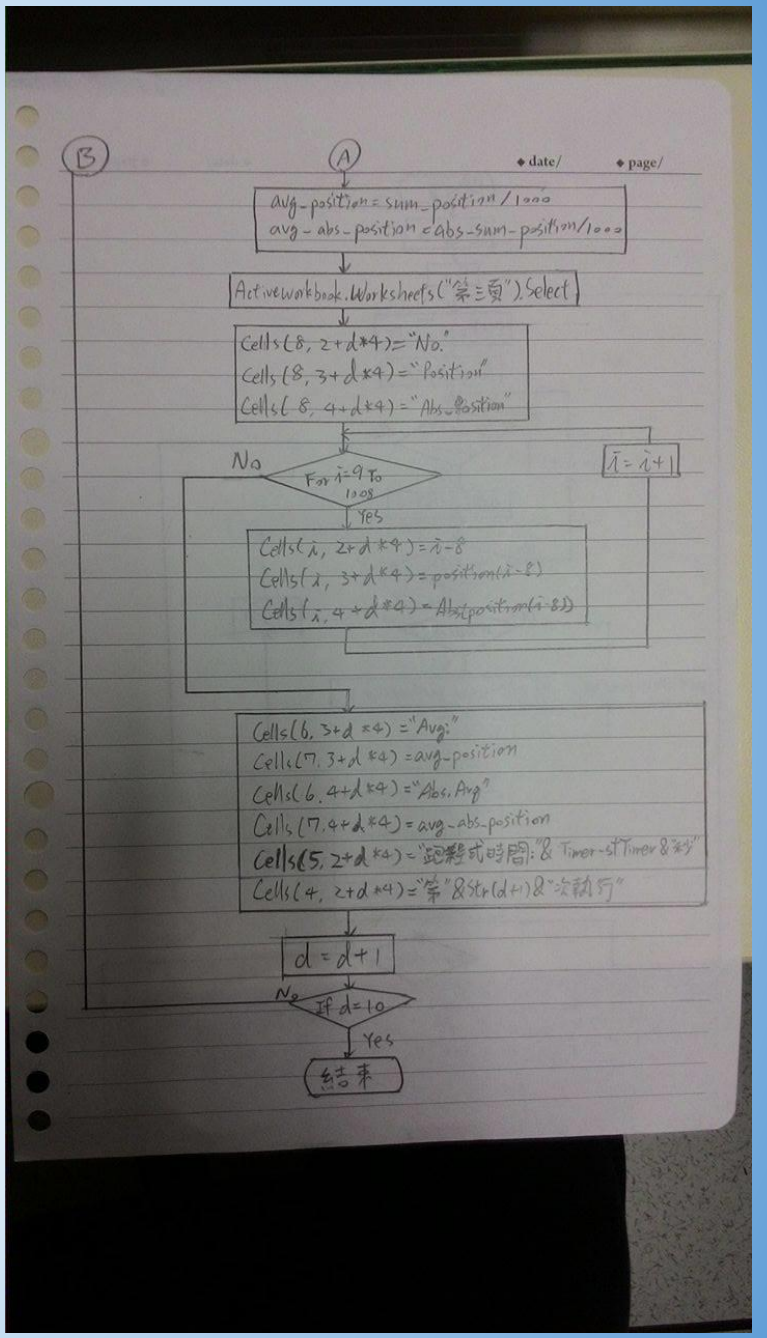
B03702108　會計三譚丞佑

2017/4/25

問題一、請劃出你所寫程式的流程圖；列出修改後的程式碼。

流程圖：





程式碼：

```
Option Explicit
Sub random_walk_1D()
Dim i&, j&, sum_position&, abs_sum_position&, sum_RSquare&, RBar&, d As Long
Dim position(1 To 1000) As Long
Dim stTimer!, avg_abs_position!, avg_position!, k As Single

ActiveSheet.Cells.Clear

RandomizeX

d = 0
Do
stTimer = Timer

    For i = 1 To 1000
        position(i) = 0
        For j = 1 To 10000
            If RndX > 0.5 Then
                position(i) = position(i) + 1
                Else
                position(i) = position(i) - 1
            End If
        Next
    Next

    sum_position = 0
    abs_sum_position = 0
    avg_position = 0
    avg_abs_position = 0
    'sum_RSquare = 0

    For i = 1 To 1000
        sum_position = sum_position + position(i)
        abs_sum_position = abs_sum_position + Abs(position(i))
        'sum_RSquare = sum_RSquare + (Abs(position(i))) ^ 2
    Next
    avg_position = sum_position / 1000
    avg_abs_position = abs_sum_position / 1000
    'RBar = sum_RSquare / 1000
    ActiveWorkbook.Worksheets("第三頁").Select
    Cells(8, 2 + d * 4) = "No."
    Cells(8, 3 + d * 4) = "Position"
    Cells(8, 4 + d * 4) = "Abs_Position"
    For i = 9 To 1008
        Cells(i, 2 + d * 4) = i - 8
        Cells(i, 3 + d * 4) = position(i - 8)
        Cells(i, 4 + d * 4) = Abs(position(i - 8))
    Next
    Cells(6, 3 + d * 4) = "Avg:"
    Cells(7, 3 + d * 4) = avg_position
    Cells(6, 4 + d * 4) = "Abs.Avg:"
    Cells(7, 4 + d * 4) = avg_abs_position
    'ActiveSheet.Cells(1006, 2).Value = "方均根："
    'ActiveSheet.Cells(1006, 3).Value = Sqr(RBar)
    Cells(5, 2 + d * 4) = "跑程式時間：" & Timer - stTimer & "秒"
    Cells(4, 2 + d * 4) = "第" & Str(d + 1) & "次執行"

    d = d + 1

Loop Until d = 10

End Sub
```

問題二、請列出此模擬(即一千個顆粒，各跳一萬次)的結果，按模擬次數序號、跳一萬次後之位置、跳一萬次後距原點之距離(絕對值)、跑程式時間等四項列表。

執行結果(部分)：

第 1次執行			第 2次執行			第 3次執行			第 4次執行			第 5次執行		
跑程式時間：2.425781秒			跑程式時間：2.273438秒			跑程式時間：2.285156秒			跑程式時間：2.25秒			跑程式時間：2.265625秒		
	Avg:	Abs.Avg:		Avg:	Abs.Avg:		Avg:	Abs.Avg:		Avg:	Abs.Avg:		Avg:	Abs.Avg:
	3.638	77.938004		-1.154	78.685997		0.298	80.650002		-1.31	82.806		1.5319999	82.816002
No.	Position	Abs_Position	No.	Position	Abs_Position	No.	Position	Abs_Position	No.	Position	Abs_Position	No.	Position	Abs_Position
1	-30	30	1	-50	50	1	-106	106	1	-152	152	1	-30	30
2	-38	38	2	-152	152	2	80	80	2	-264	264	2	-94	94
3	-100	100	3	-56	56	3	122	122	3	-136	136	3	74	74
4	-100	100	4	-52	52	4	-16	16	4	-22	22	4	-122	122
5	210	210	5	32	32	5	250	250	5	32	32	5	30	30
6	-88	88	6	4	4	6	110	110	6	-86	86	6	-6	6
7	170	170	7	14	14	7	154	154	7	-14	14	7	118	118
8	50	50	8	90	90	8	-72	72	8	12	12	8	-178	178
9	-32	32	9	-16	16	9	80	80	9	-56	56	9	-232	232
10	194	194	10	46	46	10	-42	42	10	-64	64	10	82	82
11	-10	10	11	-70	70	11	-108	108	11	-36	36	11	112	112
12	36	36	12	20	20	12	-78	78	12	8	8	12	-14	14
13	-120	120	13	-134	134	13	160	160	13	52	52	13	132	132
14	50	50	14	32	32	14	0	0	14	-46	46	14	-170	170
15	28	28	15	-92	92	15	250	250	15	48	48	15	-42	42
16	66	66	16	40	40	16	-94	94	16	26	26	16	88	88
17	-50	50	17	-92	92	17	52	52	17	114	114	17	-38	38
18	34	34	18	-138	138	18	122	122	18	124	124	18	50	50
19	-8	8	19	-18	18	19	-32	32	19	-20	20	19	-132	132
20	54	54	20	140	140	20	-150	150	20	150	150	20	-72	72
21	168	168	21	62	62	21	-56	56	21	-40	40	21	-8	8
22	24	24	22	-104	104	22	62	62	22	20	20	22	36	36
23	-60	60	23	44	44	23	72	72	23	-164	164	23	-36	36

問題三、請算出這模擬共1000個顆粒跳動後的總平均位置、總平均距離、距離的方均根。可不可以看出這三個值與跳動次數的關係？

程式碼：

ANS：與跳動次數無關，因亂數夠亂。

```
Option Explicit
Sub random_walk_relation()
Dim i&, j&, x%
Dim sum_posx&, sum_posy&, sum_angle!, sum_distance!
Dim avg_posx!, avg_posy!, avg_angle!, avg_distance!
Dim posx&(1 To 1000), posy&(1 To 1000), angle!(1 To 1000)
Dim pi!, time!, k!
x = 0
Do
time = Timer
pi = 3.14159

ReDim pos(10000)
RandomizeX
For i = 1 To 1000
    posx(i) = 0
    posy(i) = 0
        For j = 1 To 1000 + x * 100
            pos(j) = 2 * pi * RndX
            posx(i) = posx(i) + Cos(pos(j))
            posy(i) = posy(i) + Sin(pos(j))
        Next j
        If posx(i) > 0 And posy(i) >= 0 Then
        angle(i) = Atn(posy(i) / posx(i)) * 180 / pi

        ElseIf posx(i) < 0 And posy(i) >= 0 Then
        angle(i) = Atn(posy(i) / posx(i)) * 180 / pi + 180

        ElseIf posx(i) < 0 And posy(i) < 0 Then
        angle(i) = Atn(posy(i) / posx(i)) * 180 / pi + 180

        ElseIf posx(i) > 0 And posy(i) < 0 Then
        angle(i) = Atn(posy(i) / posx(i)) * 180 / pi + 360

        ElseIf posx(i) = 0 And posy(i) > 0 Then
        angle(i) = 90

        ElseIf posx(i) = 0 And posy(i) < 0 Then
        angle(i) = 270

        End If
Next i

    sum_posx = 0
    sum_posy = 0
    sum_angle = 0
    sum_distance = 0

For i = 1 To 1000
```

```
sum_posx = sum_posx + posx(i)
sum_posy = sum_posy + posy(i)
sum_angle = sum_angle + angle(i)
sum_distance = sum_distance + (posx(i) ^ 2 + posy(i) ^ 2)
Next i

    avg_posx = sum_posx / 1000
    avg_posy = sum_posy / 1000
    avg_distance = Sqr(avg_posx ^ 2 + avg_posy ^ 2)
    avg_angle = sum_angle / 1000
    k = Sqr(sum_distance / 1000)

ActiveWorkbook.Worksheets("工作表2").Select
    ActiveSheet.Cells(3, 2).Value = "跳動次數"
    ActiveSheet.Cells(3, 3).Value = "平均距離"
    ActiveSheet.Cells(3, 4).Value = "平均方位角"
    ActiveSheet.Cells(3, 5).Value = "距離方均根"
    ActiveSheet.Cells(3, 6).Value = "執行時間"

    ActiveSheet.Cells(x + 4, 2) = 1000 + x * 100
    ActiveSheet.Cells(x + 4, 3) = avg_distance
    ActiveSheet.Cells(x + 4, 4) = avg_angle
    ActiveSheet.Cells(x + 4, 5) = k
    ActiveSheet.Cells(x + 4, 6) = Timer - time
    x = x + 1
    Loop Until x > 90
End Sub
```

問題四、如果每次跳動有三種可能(向左、不動、向右)且機率軍相等，請問結果會有何不同？

ANS：position平均一樣在0附近，但平均Abs_position從80左右下降到65左右。

執行結果(部分)：

第 1次執行			第 2次執行			第 3次執行			第 4次執行			第 5次執行		
跑程式時間：		2.1640625	跑程式時間：		4.3066406	跑程式時間：		6.4609375	跑程式時間：		8.6171875	跑程式時間：		10.787109
	Avg:	Abs.Avg:		Avg:	Abs.Avg:		Avg:	Abs.Avg:		Avg:	Abs.Avg:		Avg:	Abs.Avg:
	-1.18	64		-3.184	65.660004		2.141	63.311001		1.008	65.265999		1.074	64.043999
No.	Position	Abs_Position	No.	Position	Abs_Position	No.	Position	Abs_Position	No.	Position	Abs_Position	No.	Position	Abs_Position
1	-22	22	1	-47	47	1	-20	20	1	-38	38	1	104	104
2	-91	91	2	-29	29	2	87	87	2	-24	24	2	37	37
3	105	105	3	-91	91	3	68	68	3	-54	54	3	-73	73
4	-48	48	4	84	84	4	36	36	4	-124	124	4	-43	43
5	63	63	5	25	25	5	94	94	5	-48	48	5	157	157
6	48	48	6	-108	108	6	6	6	6	-86	86	6	-118	118
7	-140	140	7	4	4	7	59	59	7	-133	133	7	17	17
8	-65	65	8	5	5	8	146	146	8	-104	104	8	137	137
9	-103	103	9	-170	170	9	-82	82	9	12	12	9	35	35
10	46	46	10	111	111	10	-128	128	10	93	93	10	-17	17
11	51	51	11	8	8	11	-7	7	11	-15	15	11	-139	139
12	-110	110	12	38	38	12	-156	156	12	-144	144	12	57	57
13	41	41	13	96	96	13	111	111	13	150	150	13	100	100
14	-37	37	14	90	90	14	58	58	14	132	132	14	174	174
15	-1	1	15	-48	48	15	26	26	15	-45	45	15	60	60
16	2	2	16	-64	64	16	44	44	16	-89	89	16	49	49
17	95	95	17	-99	99	17	-49	49	17	102	102	17	-46	46
18	-78	78	18	56	56	18	-72	72	18	-97	97	18	239	239
19	13	13	19	6	6	19	-5	5	19	130	130	19	49	49
20	80	80	20	50	50	20	55	55	20	-1	1	20	108	108
21	34	34	21	124	124	21	-81	81	21	-5	5	21	-10	10
22	-60	60	22	-108	108	22	-58	58	22	-30	30	22	-34	34
23	42	42	23	-40	40	23	3	3	23	-30	30	23	-86	86

問題五、請寫出你解答本題的心得或想法。

只是把課本上的程式碼修改一點東西而已，加上一點debug，並不難。

電腦數值模擬導論實習六(b)

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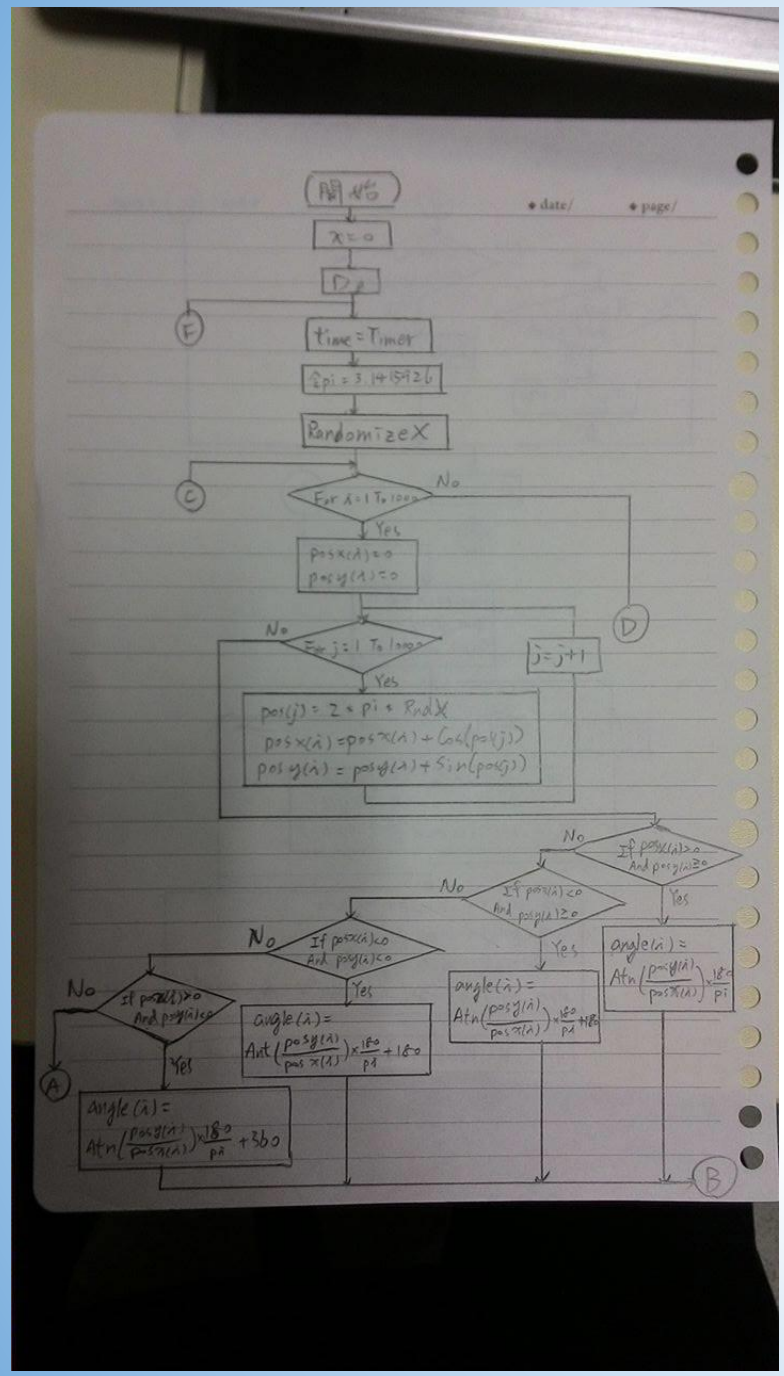
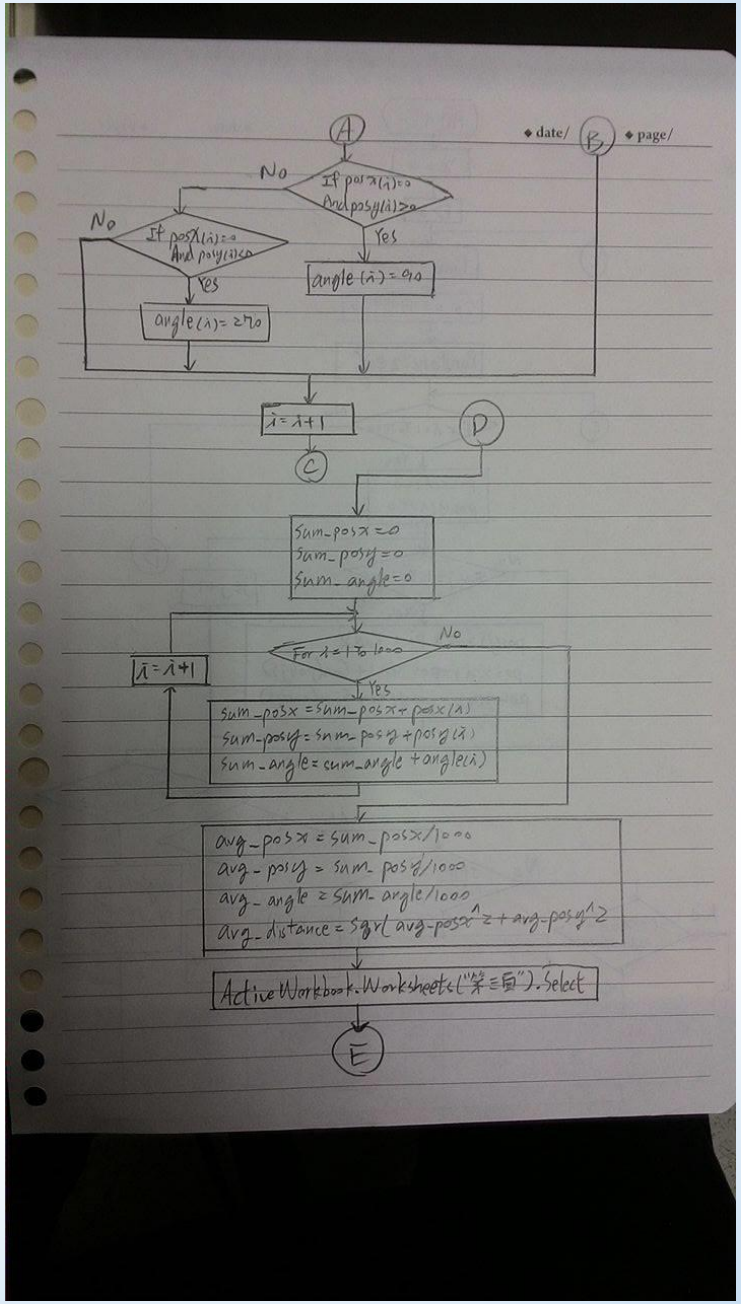
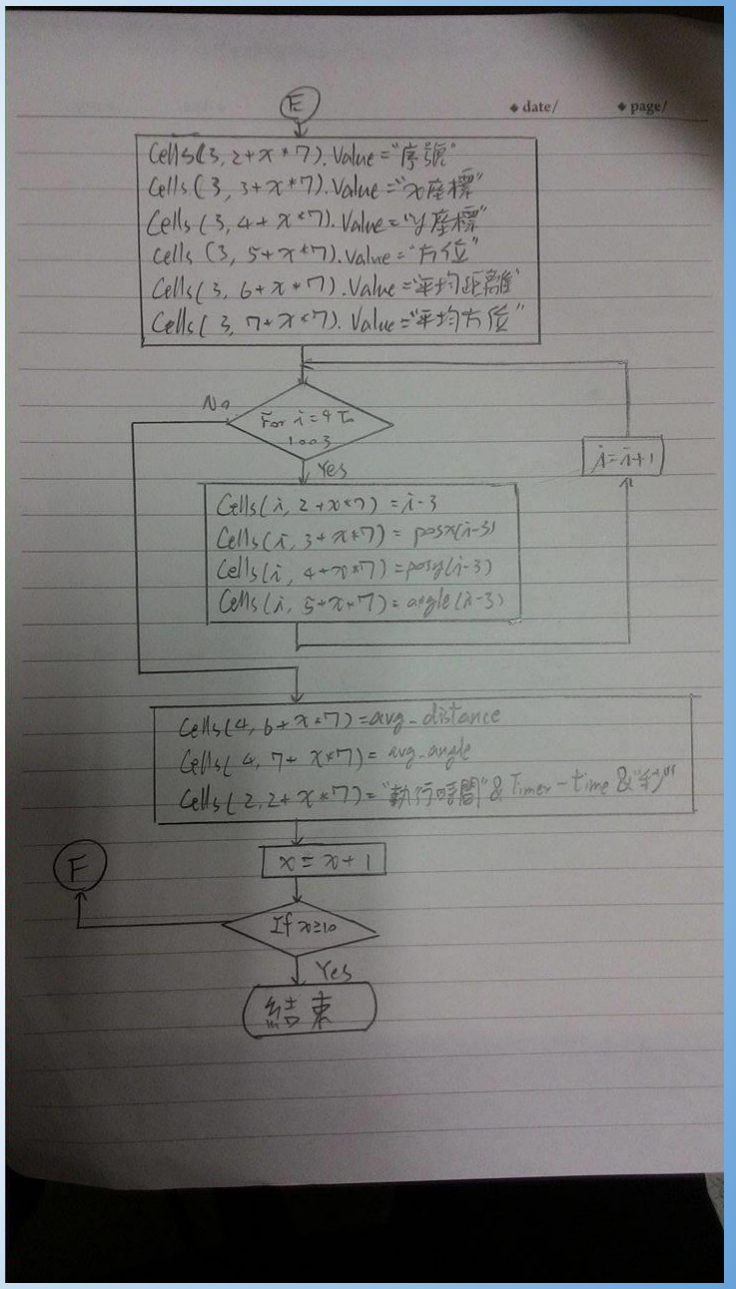
2017/4/25

問題一、請劃出你所寫程式的流程圖，並列出程式碼。

流程圖：


開始
x=0
Do
F
time=Timer
pi=3.14159265
RandomizeX
C
For i=1 To 1000
No
Yes
posx(i)=0
posy(i)=0
No
For j=1 To 1000
j=j+1
D
posj=2*pi*RndX
posx(i)=posx(i)+Cos(posj)
posy(i)=posy(i)+Sin(posj)
No
If posx(i)>0 And posy(i)>0
Yes
angle(i)=Atn(posy(i)/posx(i))*180/pi
No
If posx(i)<0 And posy(i)>0
Yes
angle(i)=Atn(posy(i)/posx(i))*180/pi+180
No
If posx(i)<0 And posy(i)<0
Yes
angle(i)=Atn(posy(i)/posx(i))*180/pi+180
No
If posx(i)>0 And posy(i)<0
Yes
A
angle(i)=Atn(posy(i)/posx(i))*180/pi+360
B


A
No
If posx(i)=0 And posy(i)>0
Yes
angle(i)=90
No
If posx(i)=0 And posy(i)<0
Yes
angle(i)=270
i=i+1
C
D
sum_posx=0
sum_posy=0
sum_angle=0
No
For i=1 To 1000
Yes
i=i+1
sum_posx=sum_posx+posx(i)
sum_posy=sum_posy+posy(i)
sum_angle=sum_angle+angle(i)
avg_posx=sum_posx/1000
avg_posy=sum_posy/1000
avg_angle=sum_angle/1000
avg_distance=Sqr(avg_posx^2+avg_posy^2)
Active Workbook.Worksheets("第三頁").Select
E


E
Cells(3,2+x*7).Value="序號"
Cells(3,3+x*7).Value="x座標"
Cells(3,4+x*7).Value="y座標"
Cells(3,5+x*7).Value="方位"
Cells(3,6+x*7).Value="平均距離"
Cells(3,7+x*7).Value="平均方位"
No
For i=4 To 1003
Yes
i=i+1
Cells(i,2+x*7)=i-3
Cells(i,3+x*7)=posx(i-3)
Cells(i,4+x*7)=posy(i-3)
Cells(i,5+x*7)=angle(i-3)
Cells(4,6+x*7)=avg_distance
Cells(4,7+x*7)=avg_angle
Cells(2,2+x*7)="執行時間"&Timer-time&"秒"
F
x=x+1
If x=10
Yes
結束

程式碼：

```
Option Explicit
Sub randomwalk_2D()
Dim i&, j&, x%
Dim sum_posx&, sum_posy&, sum_angle!
Dim avg_posx!, avg_posy!, avg_angle!, avg_distance!
Dim posx&(1 To 1000), posy&(1 To 1000), angle!(1 To 1000)
Dim pi!, time!

x = 0
Do
time = Timer

pi = 3.1415926

ReDim pos(10000)
RandomizeX
For i = 1 To 1000
    posx(i) = 0
    posy(i) = 0
        For j = 1 To 10000
            pos(j) = 2 * pi * RndX
            posx(i) = posx(i) + Cos(pos(j))
            posy(i) = posy(i) + Sin(pos(j))
        Next j

        If posx(i) > 0 And posy(i) >= 0 Then
        angle(i) = Atn(posy(i) / posx(i)) * 180 / pi

        ElseIf posx(i) < 0 And posy(i) >= 0 Then
        angle(i) = Atn(posy(i) / posx(i)) * 180 / pi + 180

        ElseIf posx(i) < 0 And posy(i) < 0 Then
        angle(i) = Atn(posy(i) / posx(i)) * 180 / pi + 180

        ElseIf posx(i) > 0 And posy(i) < 0 Then
        angle(i) = Atn(posy(i) / posx(i)) * 180 / pi + 360

        ElseIf posx(i) = 0 And posy(i) > 0 Then
        angle(i) = 90

        ElseIf posx(i) = 0 And posy(i) < 0 Then
        angle(i) = 270

       End If
Next i


    sum_posx = 0
    sum_posy = 0
    sum_angle = 0
```

```
For i = 1 To 1000

sum_posx = sum_posx + posx(i)
sum_posy = sum_posy + posy(i)
sum_angle = sum_angle + angle(i)

Next i

    avg_posx = sum_posx / 1000
    avg_posy = sum_posy / 1000
    avg_angle = sum_angle / 1000
    avg_distance = Sqr(avg_posx ^ 2 + avg_posy ^ 2)

    ActiveWorkbook.Worksheets("第三頁").Select
    ActiveSheet.Cells(3, 2 + x * 7).Value = "序號"
    ActiveSheet.Cells(3, 3 + x * 7).Value = "x座標"
    ActiveSheet.Cells(3, 4 + x * 7).Value = "y座標"
    ActiveSheet.Cells(3, 5 + x * 7).Value = "方位"
    ActiveSheet.Cells(3, 6 + x * 7).Value = "平均距離"
    ActiveSheet.Cells(3, 7 + x * 7).Value = "平均方位"

For i = 4 To 1003
        ActiveSheet.Cells(i, 2 + x * 7) = i - 3
        ActiveSheet.Cells(i, 3 + x * 7) = posx(i - 3)
        ActiveSheet.Cells(i, 4 + x * 7) = posy(i - 3)
        ActiveSheet.Cells(i, 5 + x * 7) = angle(i - 3)

Next i

    ActiveSheet.Cells(4, 6 + x * 7) = avg_distance
    ActiveSheet.Cells(4, 7 + x * 7) = avg_angle
    ActiveSheet.Cells(2, 2 + x * 7).Value = "執行第" & Str(x + 1) & "次，執行時間" & Timer - time & "秒"

x = x + 1
Loop Until x >= 10
End Sub
```

問題二、請將這至少十次模擬(每次有1000顆)的平均結果列表，應包括模擬序數、跳一萬次後與原點之平均距離(絕對值)、與原點之平均方位(角度)、x座標、y座標、 和跑程式時間等六項。

執行結果(部分)：

執行第 1次，執行時間3.462891秒

序號	x座標	y座標	方位	平均距離	平均方位
1	-43	26	148.8407	4.393816	182.44939
2	14	-182	274.39871		
3	132	-75	330.39554		
4	81	-122	303.58154		
5	-69	-38	208.84267		
6	-31	-33	226.78992		
7	-11	-49	257.34744		
8	-230	-46	191.30994		
9	-131	84	147.33113		
10	-4	37	96.170174		
11	46	149	72.843246		
12	39	-10	345.61859		
13	205	-49	346.55713		
14	-58	114	116.96571		
15	60	56	43.025066		
16	107	31	16.157341		
17	-72	48	146.30994		
18	95	9	5.4118695		
19	24	87	74.577843		
20	-29	52	119.14807		
21	-33	115	106.01118		
22	-18	139	97.378532		
23	-122	-97	218.48758		
24	142	-29	348.45746		
25	71	39	28.779808		
26	45	34	37.073074		
27	-87	176	116.30402		
28	165	-17	354.11755		

執行第 2次，執行時間3.457081秒

序號	x座標	y座標	方位	平均距離	平均方位
1	-179	-70	201.35855	8.1303291	186.27385
2	71	-113	302.14191		
3	47	123	69.087456		
4	85	-34	338.19858		
5	-148	156	133.49257		
6	26	-34	307.40536		
7	-83	68	140.67302		
8	-73	-63	220.79465		
9	-121	4	178.10661		
10	-170	22	172.62624		
11	-21	-20	223.60281		
12	-77	-35	204.44395		
13	97	-2	358.81882		
14	-27	72	110.55605		
15	135	21	8.841815		
16	2	31	86.308617		
17	65	-55	319.76364		
18	137	-116	319.7449		
19	117	-79	325.97223		
20	106	42	21.61478		
21	-23	148	98.833412		
22	-52	15	163.90918		
23	-140	-57	202.15335		
24	-104	-57	208.72614		
25	-36	24	146.30994		
26	180	69	20.973494		
27	-11	39	105.75117		
28	88	196	65.820892		

執行第 3次，執行時間3.478516秒

序號	x座標	y座標	方位	平均距離	平均方位
1	38	97	68.607117	4.1750922	182.56245
2	-12	-81	261.57303		
3	-132	-49	200.36554		
4	-25	64	111.33685		
5	25	-37	304.04593		
6	103	44	23.131422		
7	-40	-52	232.43141		
8	121	-158	307.44571		
9	-77	109	125.23822		
10	13	64	78.518013		
11	89	39	23.663141		
12	-73	44	148.92096		
13	11	-57	280.92279		
14	12	-66	280.30484		
15	146	-68	335.02809		
16	81	-27	341.56506		
17	31	7	12.724357		
18	-50	2	177.7094		
19	-51	-123	247.47943		
20	82	72	41.284714		
21	2	54	87.878906		
22	-97	6	176.46043		
23	32	51	57.893745		
24	-67	45	146.11304		
25	49	-51	313.85425		
26	-17	46	110.28255		
27	-101	126	128.71521		
28	7	-27	284.53445		

問題四、請找出這兩個值與跳動次數的關係？

執行結果(部分)：

跳動次數	平均距離	平均方位角	距離方均根	執行時間
1000	0.643218517	180.2386627	36.97707367	0.328125
1100	0.375564933	175.3877869	37.81027603	0.359375
1200	0.634448588	175.7480927	39.86716843	0.400390625
1300	1.032373905	183.8985291	40.75647354	0.435546875
1400	0.292605519	177.7754669	42.5423317	0.4609375
1500	2.001265764	180.2979279	45.32146454	0.498046875
1600	0.337001473	176.5854187	46.37443161	0.529296875
1700	0.295959443	179.004776	47.89482117	0.568359375
1800	1.772439241	184.975647	49.70107651	0.591796875
1900	1.909392834	178.3670044	51.57616806	0.63671875
2000	1.26303637	182.1043854	51.09947968	0.671875
2100	2.295401812	176.698761	53.11343384	0.693359375
2200	1.544200063	179.6627502	53.87825012	0.720703125
2300	1.980464816	174.2592316	55.49474716	0.7578125
2400	0.969120204	172.8670502	56.65283585	0.791015625
2500	2.549451113	177.0733948	56.75393295	0.818359375
2600	1.739001155	178.8704376	57.03499985	0.859375
2700	0.612249136	183.7098389	59.40066528	0.890625
2800	2.218176603	177.7075958	62.2249794	0.91796875
2900	2.789151907	176.4961548	63.27979279	0.94921875
3000	0.754933774	179.2069397	63.60865402	0.978515625
3100	1.109098792	178.9319763	62.42919159	1.015625
3200	2.220520592	178.4558411	64.00086212	1.052734375

ANS：平均距離皆位於0左右，平軍方位角則在180左右。