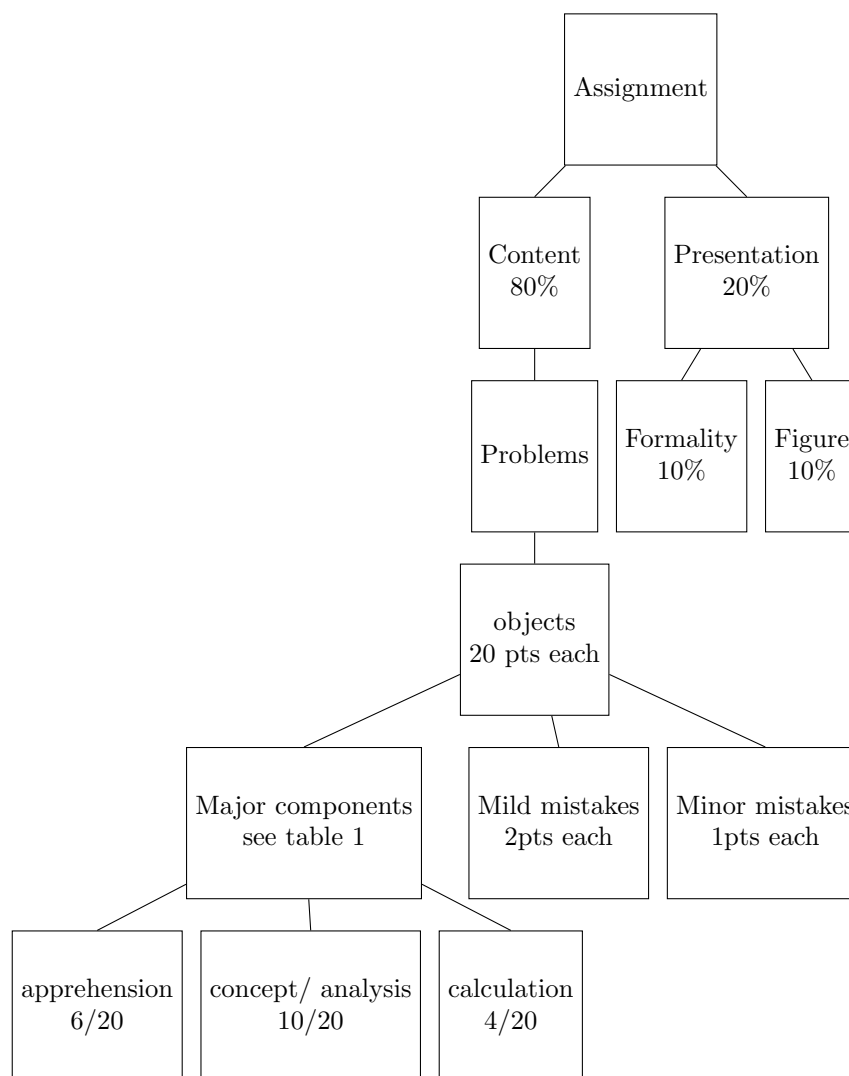


Phys 410 rubric

Ken Yeh

September 2014

1 General rubric



	Exemplary	Accomplished	Developing	Beginning	unacceptable
apprehension	6	5	3	2	0
concept/analysis	10	7	5	3	0
calculation	4	3	2	1	0

Table 1: major components of the content in each object

Presentation and content are marked separately with different values of each point. The final score from total points earned will be scaled according to their weights.

The content of each assignment is divided into problems, and each problem is further divided into objects, which are expected to achieve in the problem. In the objects, mild mistakes refer to things like computation mistake, code bug,...etc; missing conclusion, summary, reference,...etc. Minor mistakes refer to things like units, typo,...etc.

Formality judges if the report is easy to read, clarity, writing,...etc.

Figure each includes 13pts

1. 4pts graphing scheme
2. 4pts caption
3. 1×3 pts label, title, legend,...
4. 2pts fitting
5. (extra)-2pts for missing information

Well done points, 2pts for a well established argument.

2 Assignment 1

- Due date: Sep. 24, 14'
- 3 problems for error analysis
- 4 figures

Content: 105pts

1. problem 1: 30pts
2. problem 2: 25pts
3. problem 3: 50pts

Presentation: 112pts

1. formality: 56pts
2. figure 1: 14pts
3. figure 2: 14pts
4. figure 3a: 14pts
5. figure 3b: 14pts

2.1 Problem 1

Problem: Finite forward/backward summation for Riemann Zeta function $\zeta(2, N) = \sum_{n=1}^N \frac{1}{n^2}$

2.1.1 Content 30pts

20pts Object 1, comparing forward and backward summation, identify $1 + \delta\epsilon = 1$ because of finite digits used for mantissa in a float number.

	Exemplary	Accomplished	Developing	Beginning	unacceptable
apprehension	6	5	3	2	0
concept/analysis	10	7	5	3	0
calculation	4	3	2	1	0

Table 2: major components of the content in each object

5pts Object 1a, identify accumulated round-off error in backward summation of single numbers. PS this can only be seen with enough data resolution around $N \sim 10^{-7}$.

5pts Object 1b, identify linear error $\Delta = O(h)$.

2.1.2 Presentation 14pts

14pts Forward/Backward summation figures of fractional error, $\frac{\zeta(2,N) - \zeta(2,\infty)}{\zeta(2,\infty)}$ vs $1/N$:

1. 4pts graphing scheme=loglog plot, 2pts for linear plot with zooming, 0pts for meaningless plot, ex too few data points.
2. 5pts caption: recognize both errors, 1.(Forward) from finite digits storing numbers, float number $1 + \delta\epsilon = 1$ for small $\delta\epsilon$. It happens at about $1/N \sim 10^{-7}$; 2. (Backward) from summing errors of single precision; 3pts for one errors; 0pt for none.
3. 1×3 pts label, title, legend,...
4. 2pts fitting
5. (extra)-4pts for missing information: single/double precision,

2.2 Problem 2

Problem: differentiation $(d/dx \sin x)$ in finite element method

2.2.1 Content 25pts

20pts Object 1, oscillated error due to round-off error in discretizing sine function, and the plateau due to lacking of precision for distinguishing $f(x \pm h/2)$.

	Exemplary	Accomplished	Developing	Beginning	unacceptable
apprehension	6	5	3	2	0
concept/analysis	10	7	5	3	0
calculation	4	3	2	1	0

Table 3: major components of the content in each object

5pts Object 1a, identify error goes in second orders, $\Delta = O(h^2)$.

2.2.2 Presentation 14pts

14pts fractional error, $\frac{\sin'(x=3,h)-\cos(x=3)}{\cos(x=3)}$ vs h :

1. 4pts graphing scheme=loglog plot, 2pts for linear plot with zooming, 0pts for meaningless plot, ex too few data points.
2. 5pts caption: recognize both behaviors, 1. oscillation from rounding $f(x \pm h/2)$; 2. flat line from $f(x + h/2) = f(x - h/2)$; 3pts for one errors; 0pt for none.
3. $1 \times 3pts$ label, title, legend,...
4. 2pts fitting
5. (extra)-4pts for missing information: single/double precision,

2.3 Problem 3

Richardson extrapolations repeating prob1 and prob2.

2.3.1 Content 50pts

10pts Object 1, general expressions for Richardson extrapolation, 1st and 2nd order.

	Exemplary	Accomplished	Developing	Beginning	unacceptable
apprehension	3	3	1	1	0
concept/analysis	5	5	3	3	0
calculation	2	2	1	1	0

Table 4: major components of the content in each object

10pts Object 2, repeat prob 1; identify the power n in error $O(h^n)$ changes with the order of Richardson extrapolation; explain RE is intolerant of small h because round-off error in h is amplified with extrapolation.

	Exemplary	Accomplished	Developing	Beginning	unacceptable
apprehension	3	3	1	1	0
concept/analysis	5	5	3	3	0
calculation	2	2	1	1	0

Table 5: major components of the content in each object

5pts Object 2a, $O(h)$ and $O(h^2)$

5pts Object 2b, single and double precisions

10pts Object 3, repeat prob 2; identify the power n in error $O(h^n)$ changes with the order of Richardson extrapolation; recognize even cosine results in ineffective first order correction but only a shift; explain the error increases again for much sensible h.

	Exemplary	Accomplished	Developing	Beginning	unacceptable
apprehension	3	3	1	1	0
concept/analysis	5	5	3	3	0
calculation	2	2	1	1	0

Table 6: major components of the content in each object

5pts Object 3a, $O(h)$ and $O(h^2)$

5pts Object 3b, single and double precisions

2.3.2 Presentation 28pts

14pts Forward/Backward summation figures of fractional error, $\frac{\zeta(2,N)-\zeta(2,\infty)}{\zeta(2,\infty)}$ vs $1/N$:

1. 4pts graphing scheme=loglog plot, 2pts for linear plot with zooming, 0pts for meaningless plot, ex too few data points.
2. 5pts caption: recognize slopes corresponding to error orders, extrapolated error goes back to error from operation with unrecognizable numbers; 3pts for one errors; 0pt for none.
3. 1×3 pts label, title, legend,...
4. 2pts fitting
5. (extra)-2pts for missing information: single/double precision, forward/backward summation, first/second order.

14pts fractional error, $\frac{\sin'(x=3,h)-\cos(x=3)}{\cos(x=3)}$ vs h :

1. 4pts graphing scheme=loglog plot, 2pts for linear plot with zooming, 0pts for meaningless plot, ex too few data points.

2. 5pts caption: recognize both behaviors, 1. oscillation from rounding $f(x \pm h/2)$; 2. flat line from $f(x + h/2) = f(x - h/2)$; 3pts for one errors; 0pt for none.
3. $1 \times 3pts$ label, title, legend,...
4. 2pts fitting
5. (extra)-4pts for missing information: single/double precision,