

ACTIVE LEARNING IN PURE MATHEMATICS

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University of Newcastle

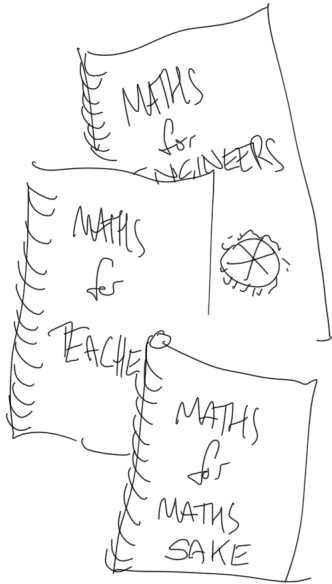
Presentation for

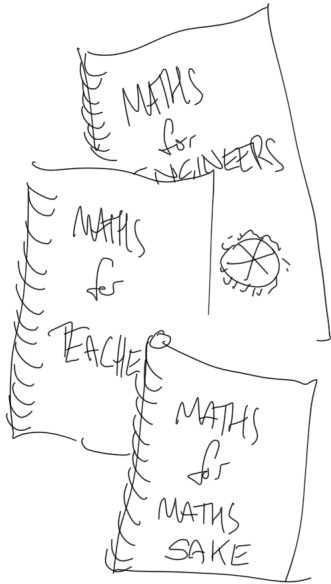
Jon Borwein Commemorative Conference

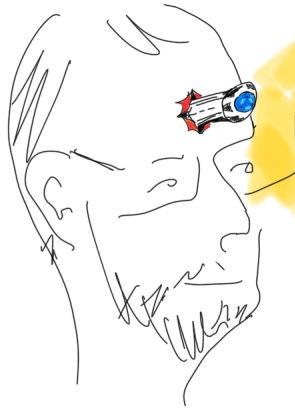
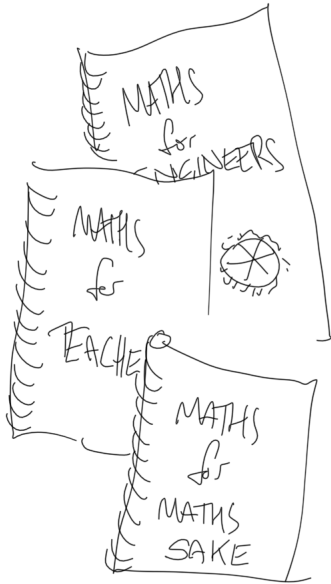
25-29 September 2017

Newcastle NSW

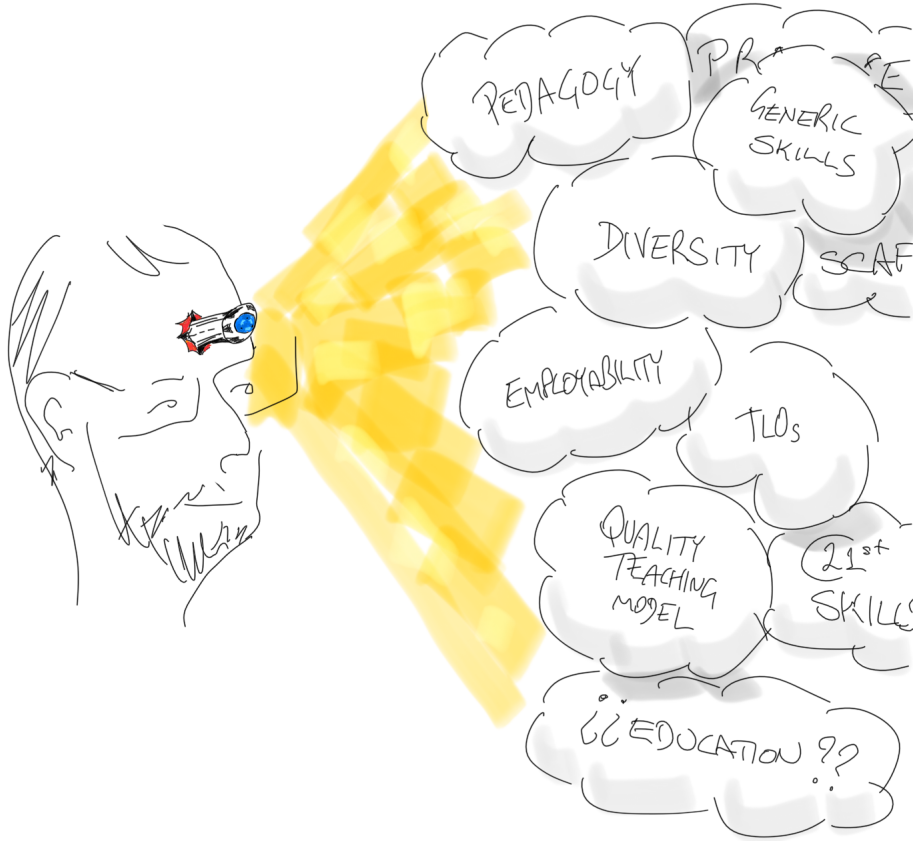








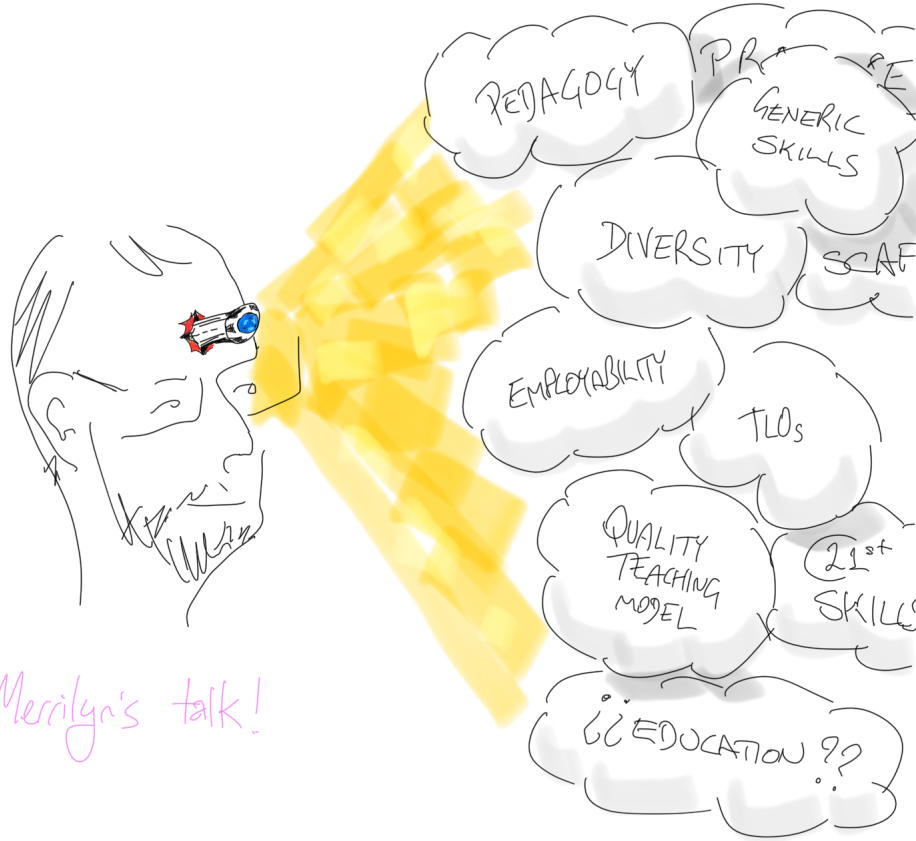
Developing an
"Education eye"
"informed by
genuine sustained
interaction
"across the creek".



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"Education eye"
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interaction
"across the creek".

⇒ ETMST/IMSITE?

Partly - see Marilyn's talk!



ACKNOWLEDGEMENTS



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[INFLUENCES
& THANKS]



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Outreach:
Extension
& Enrichment
Briley Janet Riek
Joe



MATH 1980

Bill Moxley
Tangui

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T&L
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Les Per Bill
John Miller

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MATHXXXX
Dave Jacqui Ian
Ian Eyr Wajezek

MATH1920
Bill Mux2 Jacqui

MATH2920
MATH3910
Malcolm



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T&L
Admin
Les, Pam, Bill
John, Mike

T&L
innovators
John, Pam, Mike
John, Mike, Adam

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Briley, Janet, Rick
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T&L
events
AustMS
OLT, AEMS, MANSO
Fremantle

MATHXXXX
Dave, Jacqui, Ian
Ian, Eyn, Wajezel
Sean, Jeff

WHITEBOARDING
Lorraine, Bob
Kara, Will

MATH1920
Bill, M1x2, Jacqui

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Olympiads
Peter Warren John
Mike Cheryl

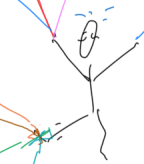
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CARMA
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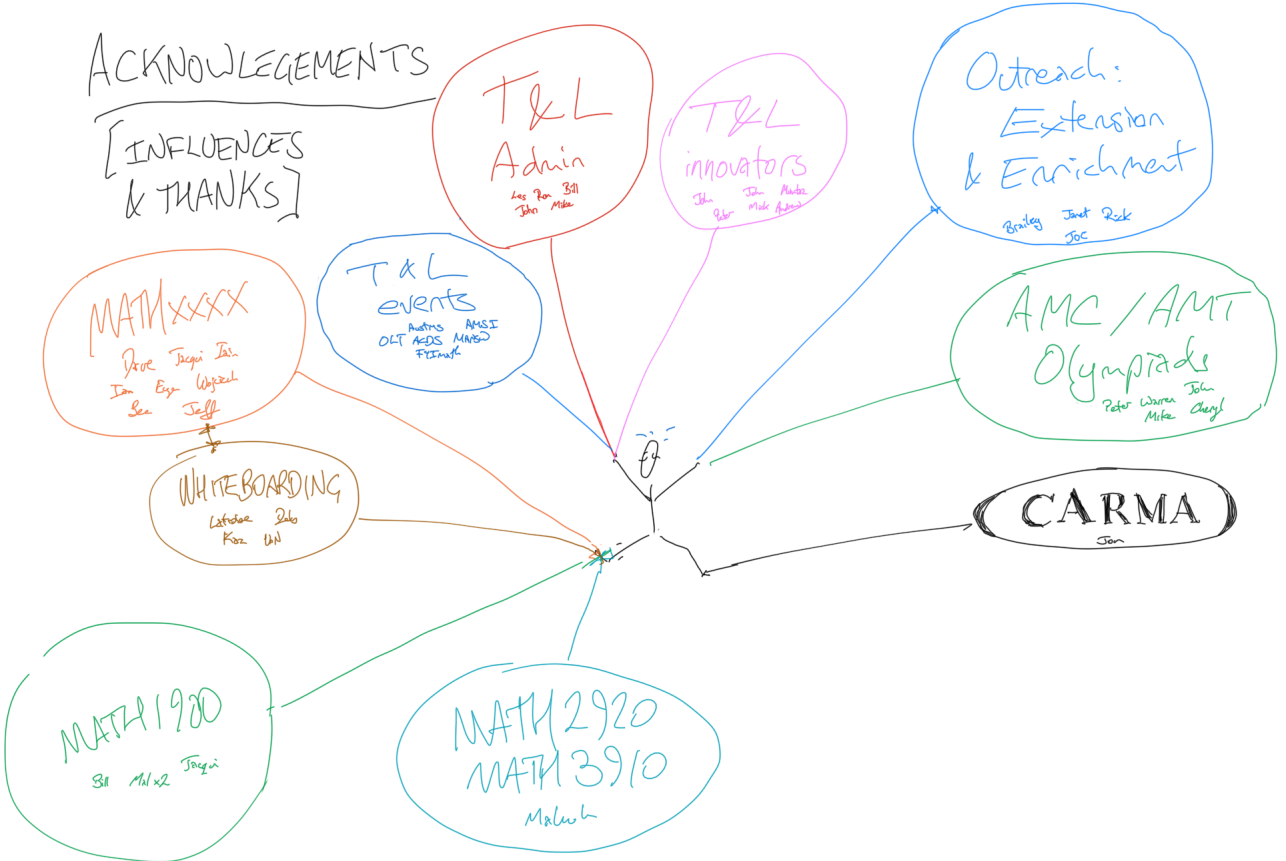
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NUMERIC
John

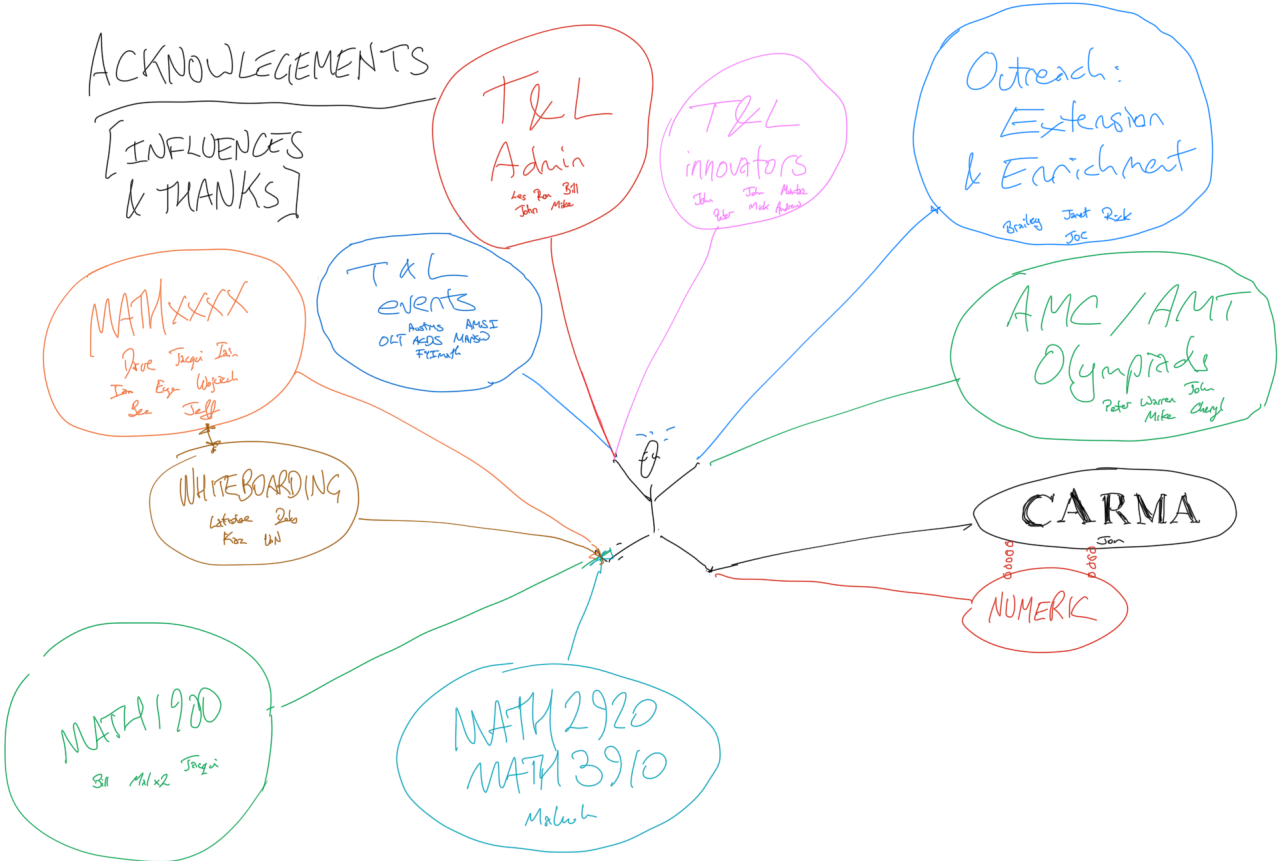
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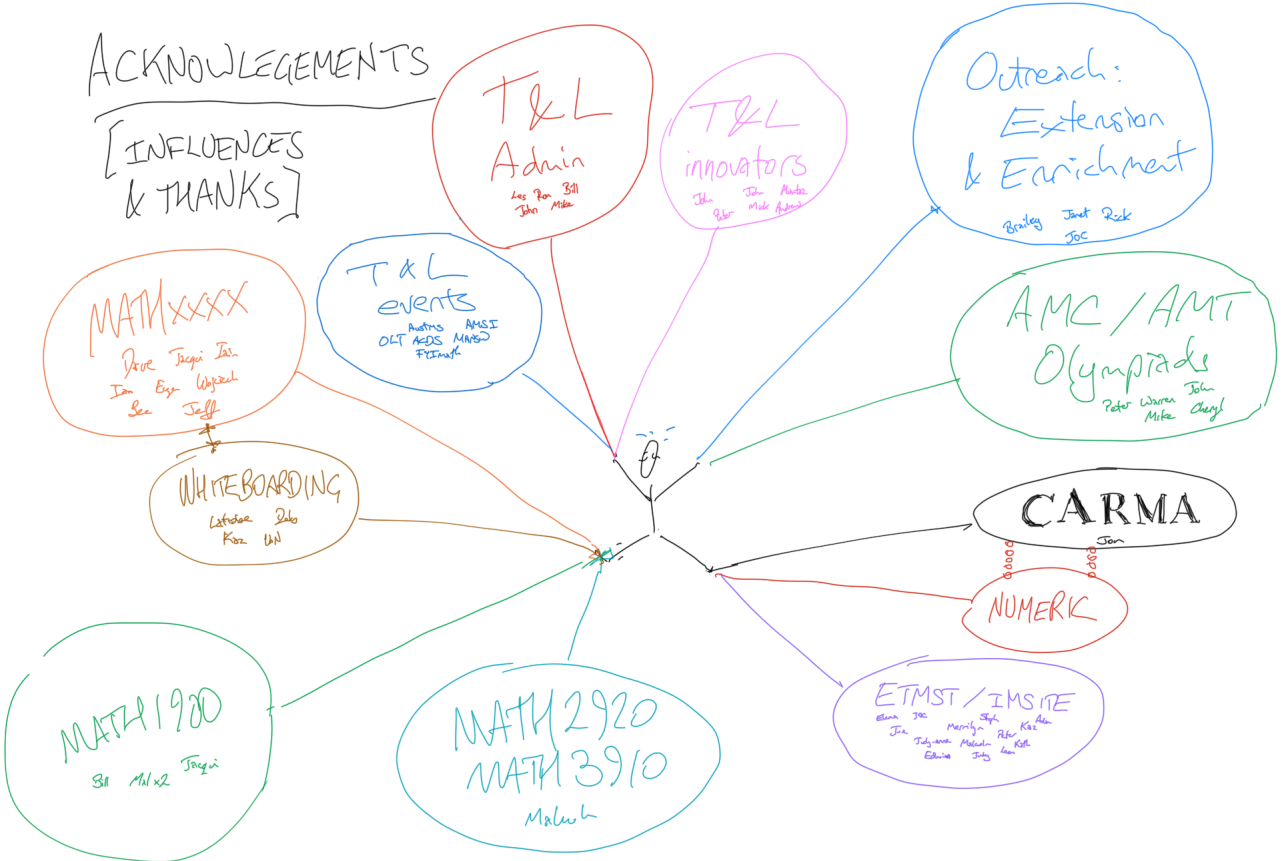
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NUMERIC

ETMST / IMSITE
Elton Joe Maryn Kay
John Julianne Michael Peter
Edwin John Ken

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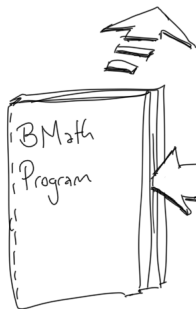
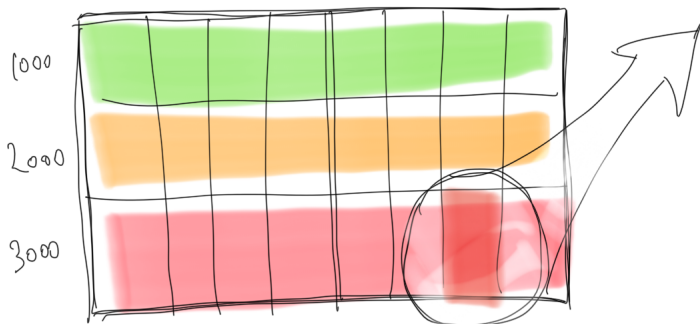
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OBSERVATIONS

PROGRAM (DEGREE)



Program Outcomes

- Communication skills
- ... Collaboration with others
- Effective communication within Mathematical and broader community
- Capacity to work in 2 team

Generic Skills / TLOs : similar

MATH 3XXX

COURSE (SUBJECT)

Learning Outcomes

- an ability to communicate a convincing and reasoned argument of a mathematical nature in both written and oral form

Content

- maths
- maths
- maths
- maths

} often lecture-heavy.

Assessment

- Written Assignments
- Examination

- ▶ This style of course doesn't work for all our students.
- ▶ Maybe we cover communication "in context" but we don't assess and can't document how.

CHALLENGE

2014, week -1 of Semester

"Ian's leaving - we need someone to teach MATH3xxx"

Andrew

- Has a full load
- Is head of Mathematics
- Is at Durimban campus
- Is on IMSITE team
- Is O8 position

CHALLENGE

2014, week -1 of Semester

"Ian's leaving - we need someone to teach MATH3xxx"

Has been talking to Ian about MATH3xxx

Has observed Ian's success with student-centred instruction

Would like working with a small group of talented pure maths students.

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Ian

OK then...

GOALS & STRATEGIES

- Survive
- Keep student-centred focus
- Steal "Whiteboarding" from MATH 1xxx
- Cover some amount of mathematics
- Put course and program outcomes in "being a mathematician" context
- Authentic activities and assessment
- This course exists to help students develop.
- Instruction on communication/collaboration in class, in context, with immediate feedback.

GOALS & STRATEGIES

- Survive (?)
- Keep student-centred focus
- Steal "Whiteboarding" from MATH 1xxx
- Cover some amount of mathematics
- Put course and program outcomes in "being a mathematician" context
- Authentic activities and assessment ← Investigation, project
- This course exists to help students develop.
- Instruction on communication/collaboration in class, in context, with immediate feedback.
(... and less out-of-class marking)

Problem solving
Collaboration
Communication

GOALS & STRATEGIES

→ Survive (?)

→ Keep student-centered focus

→ Steal "Whiteboard" **INNOVATION ACTIVE LEARNING** xxx

AMC, MATH 2920
Problem Solving
Collaboration
Communication

→ Cover some amount of mathematics

→ Put course **ETMST/INSITE** "Taught as practical" in "best T&L Admin: Grad. Attributes" contact

→ Authentic activities and assessment → Investigation, project

→ This **MATH 2920/3910** to help students develop. Experimental

→ Instruction on communication in class, in context, with in **T&L: Learning Outcomes**.
(... and less out-of-class marking)

DESIGN

$$\sum_{k=1}^{12} \text{TUESDAY}_k :$$

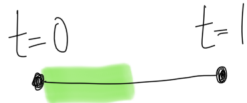


FOOD
+
COFFEE



DESIGN

$\sum_{k=1}^{12}$ TUESDAY_k :



THURSDAY_{k-1} :

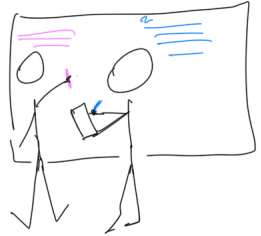
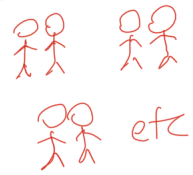


RandomPermute(class);

Attempt all questions.
Prepare to lead a discussion
on your initialled question

TUESDAY_k : $0 \leq t \leq 0.5$

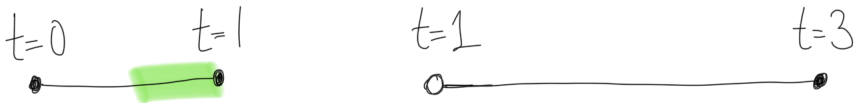
RandomPermute(Class);



Q:
Bottlenecks
Significance
Meaning
Connections

DESIGN

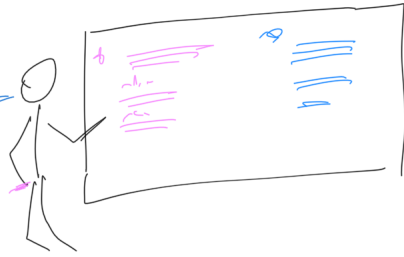
$\sum_{k=1}^{12}$ TUESDAY_k :



TUESDAY_k

$0.5 \leq t \leq 1$

Key idea,
Trick
Significance,
Connection
(2-3 min)



Feedback
Commentary
Mark



THURSDAY_k : Resubmit revision, if necessary.

DESIGN

$$\sum_{k=1}^{12} \text{TUESDAY}_k :$$

$\text{TUESDAY}_k \quad 1 < t \leq \frac{4}{3}$



Reflection & consolidation

- Key themes from presented problems
- Illustrate theory-so-far with examples
- Adapt Question #N into Theorem X.Y

$\text{TUESDAY}_k \quad \frac{4}{3} < t \leq 3$



Lecture

- Fairly traditional
- Refer to, and build on students' work as much as possible.

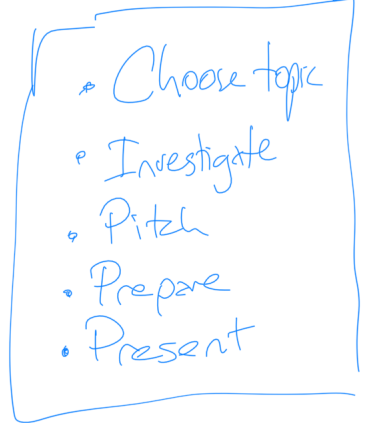
ASSESSMENT


30% Weekly workshop problems (10×3%)

5% Collaborative writing & review: Sample exam

15% Project & presentation

50% Exam

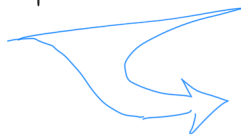
- 
- Choose topic
 - Investigate
 - Pitch
 - Prepare
 - Present



Discuss in pre-exam
review session

INCIDENTALS

- Natural to talk about mathematical behaviours
- Some components of assessment are "background-agnostic"
- Some amazing projects with connections to Biol, Phys, Music
- It didn't feel like I was losing 1/3 of "my" time.
- OK for small class & small-medium class.
- Gained a very good understanding of each student's abilities, and used that to help each student as an individual.
- Fun! 😊
- Class diversity? ☹️

 This is transforming my teaching interests and philosophy.

OUTCOMES

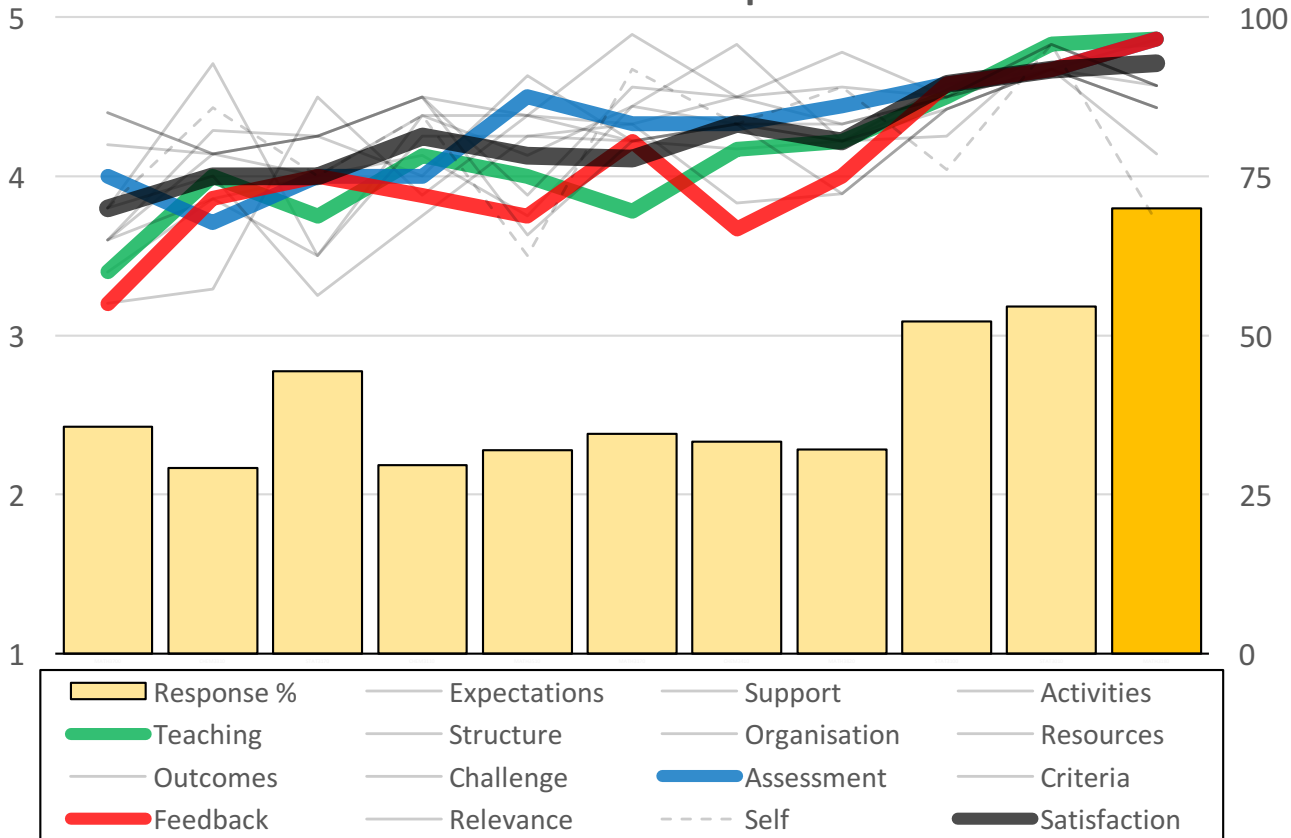
- Attendance & participation good
- Results match other MATH3--- courses (cohort, individual)
- I can demonstrate how this course contributes to graduate profile.

- Nice feedback

"Phenomenal!" "Best in 5 years at UoN."
"Good feedback" "Exceptional"

"I wasn't happy with my effort..."
"I wish I had made more effort"

SFC 2017s1: 3000 level comparison courses



NEXT:

Continue to listen and learn

Influence anyone willing to listen

Brokerage — keep at it.

Thanks!

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