Blended Learning in Mathematics Support

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Who are we?

Lecturers at the University of Sydney

At the Mathematics Learning Centre

Who do we teach?

Students who do not meet the assumed mathematics knowledge for their course.

- Students who have not done the required mathematics at school
- Students who have not achieved a specific grade at school
- Students who have had a break or worked for a number of years
- Students who have not passed courses in the past
- Mature age students
- Interstate or international students
- Students with a disability

What are our students like?

Our students:

- Often start their course without the assumed background
- Lack confidence in mathematics
- Are anxious about mathematics
- Are downright terrified of mathematics
- Students for whom the standard methods have failed them
- Students who think differently

Who are we not?

We are not “their lecturers”

Who are we not?

None of our students have to attend any of our courses to satisfy any requirement of any unit of study at the university.

Mathematics Support:

- non compulsory, extra, non-credited
- during enrolled study
- assists in developing confidence and skills

(MacGillivray 2008)

What do we teach?

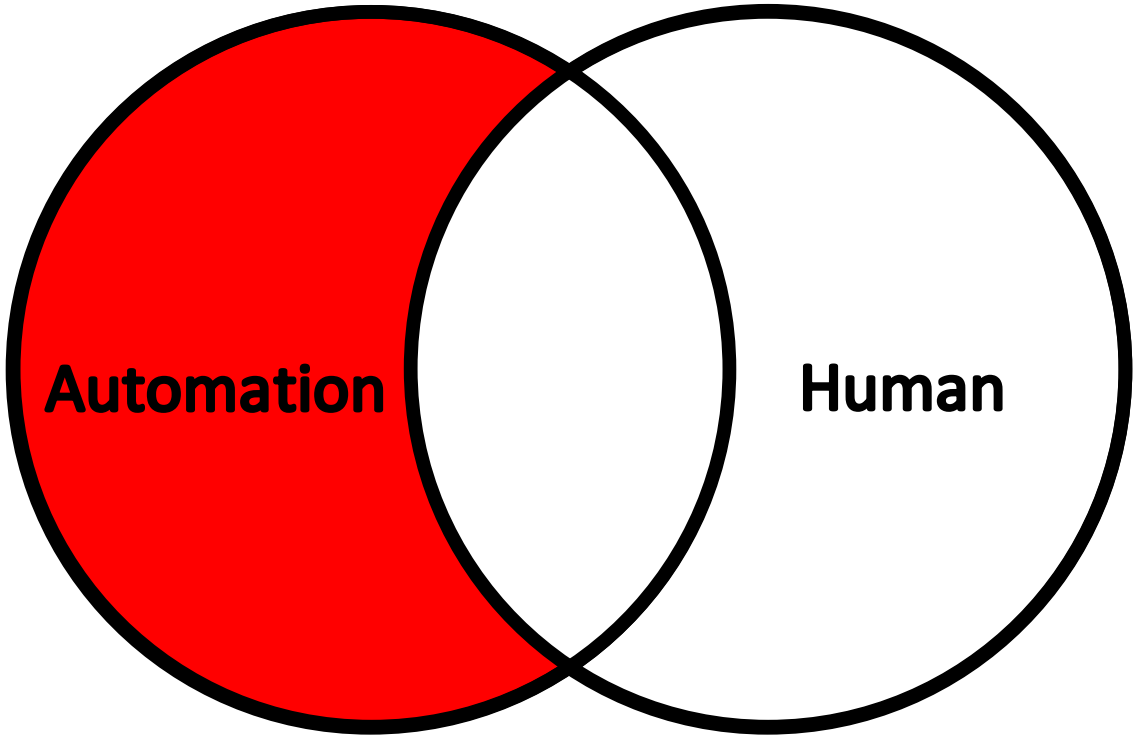
$$\pi \int_0^5 [f(x)]^2 dx = \pi \int_0^5 \sin^2(x) dx = \frac{\pi}{2} \int_0^5 (1 - \cos 2x) dx \ldots$$

Teach mathematics and mathematics related units of study for undergraduate and postgraduate students.
Our courses include:

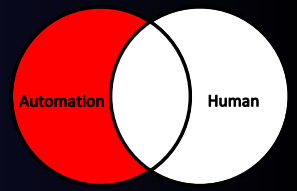
- Calculus
- Algebra
- Mathematical modelling
- Statistics
- Discrete mathematics
- Econometrics
- Master of Public Health

How do we teach?

Many of our teaching modes employ technological resourses.



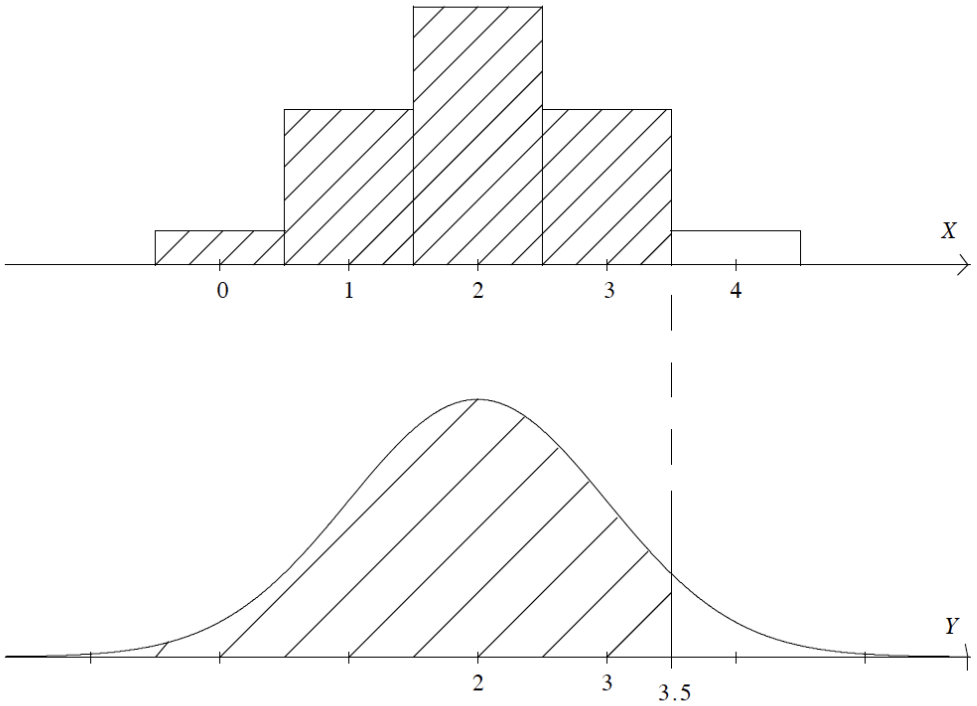
How do we teach?



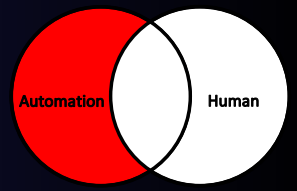
There are a wide range of online static resources

As we can see, we will obtain a better normal approximation by using the area to the left of $Y = 3.5$.

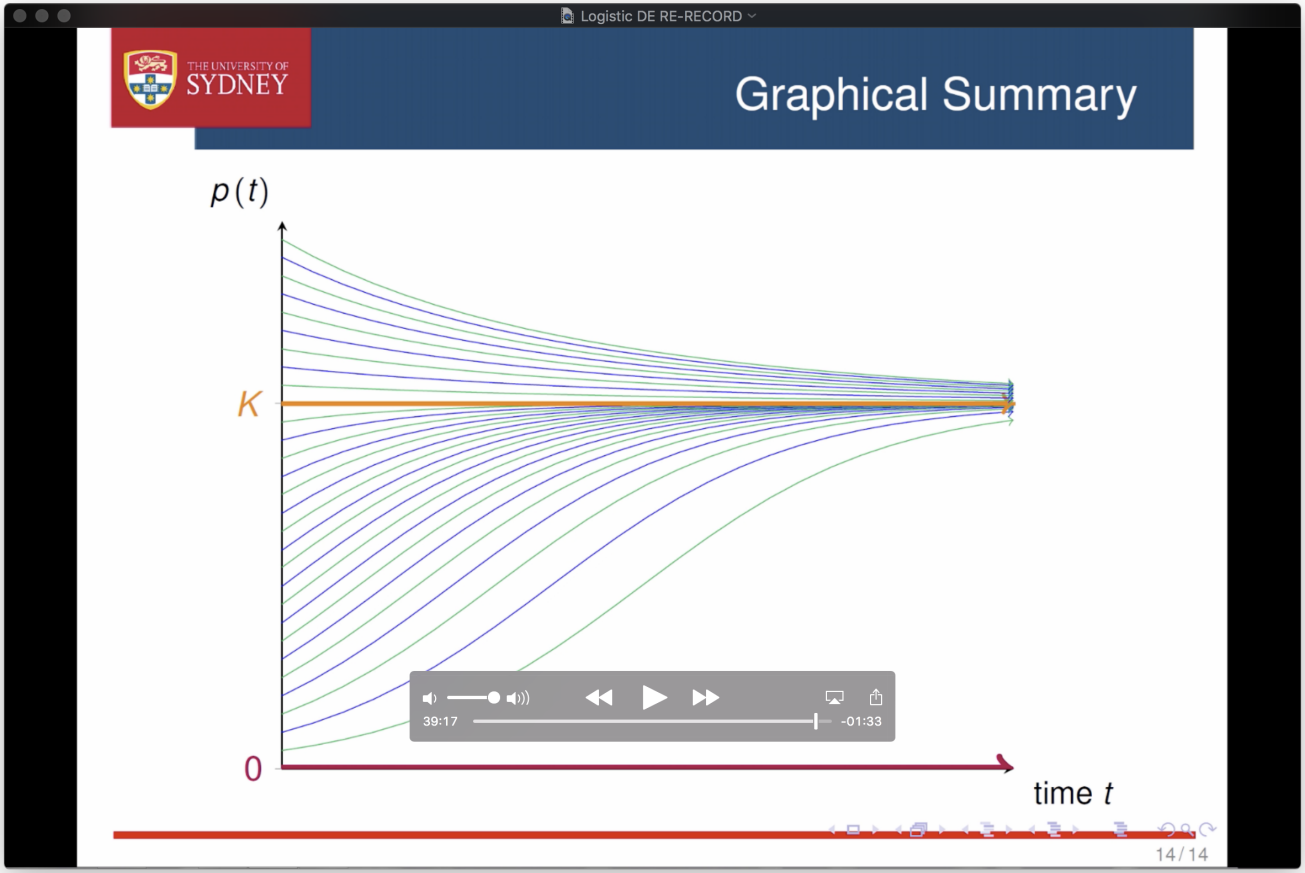
This is illustrated in the representations below where the $P(X \leq 3)$ and $P(Y \leq 3.5)$ are shown.



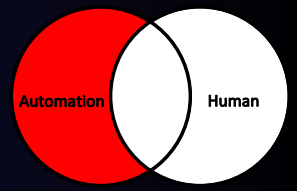
How do we teach?



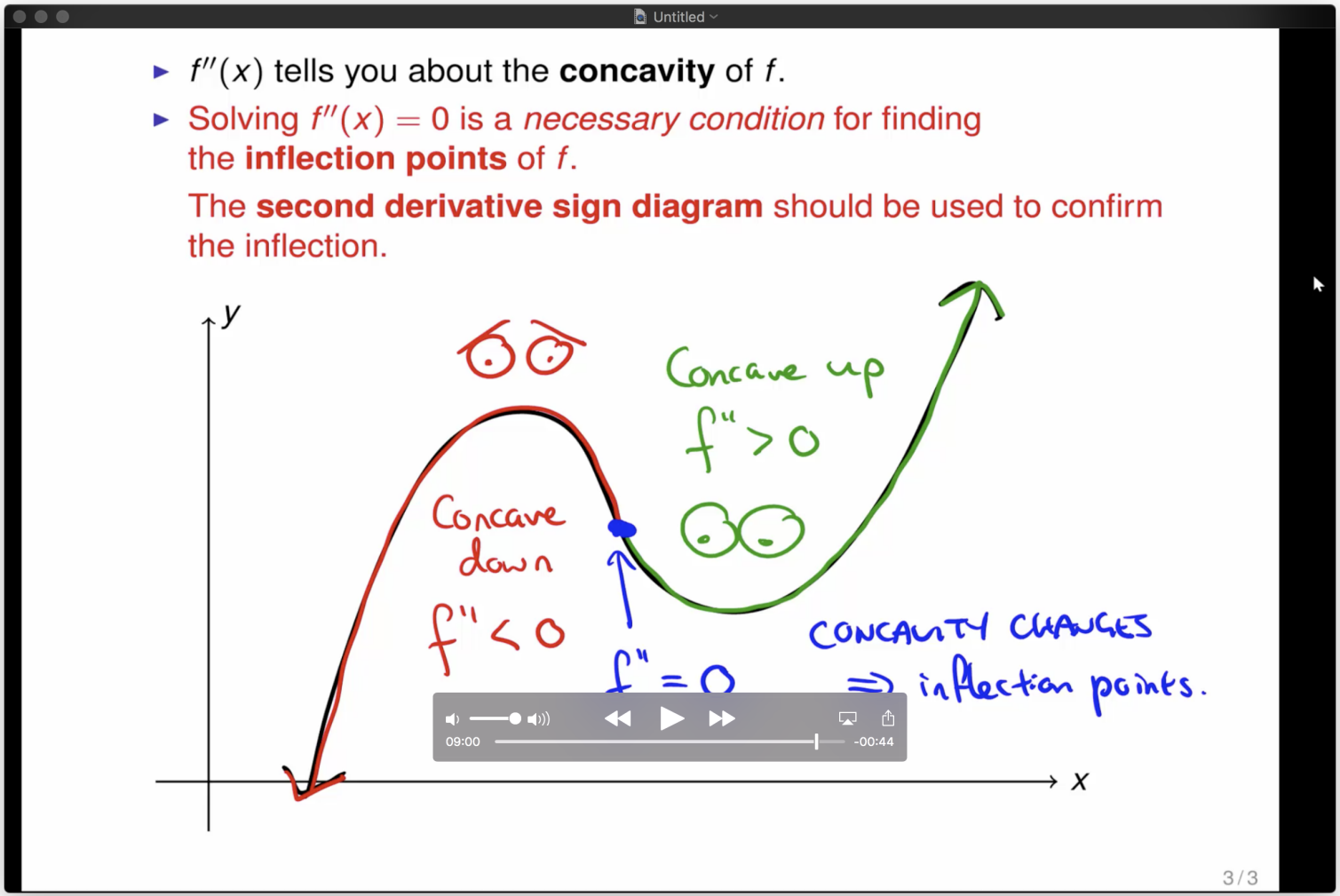
We have detailed online presentations.
For example: How to solve the logistic differential equation.



How do we teach?



We have short mathscasts.



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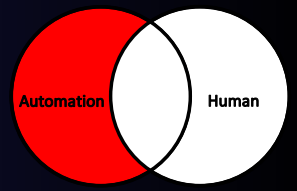
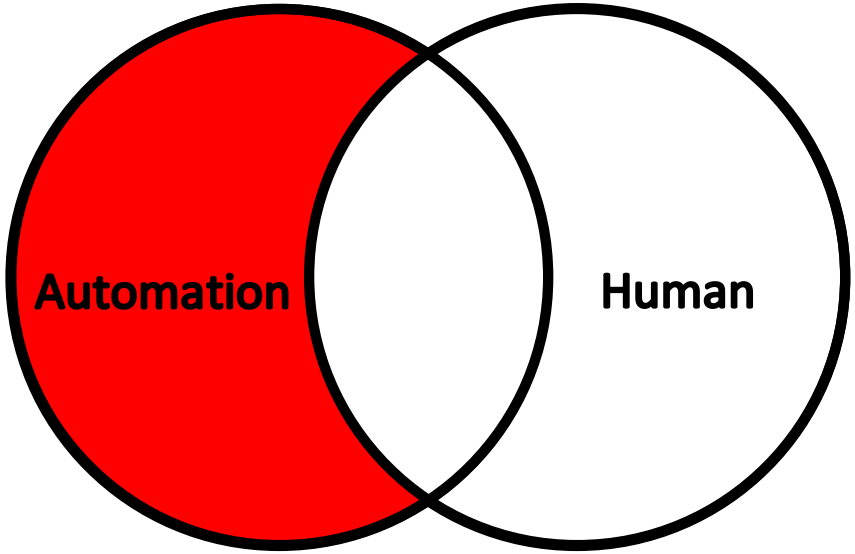


Use the **Sieve of Eratosthenes** to find all prime numbers less than 100.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Automated delivery

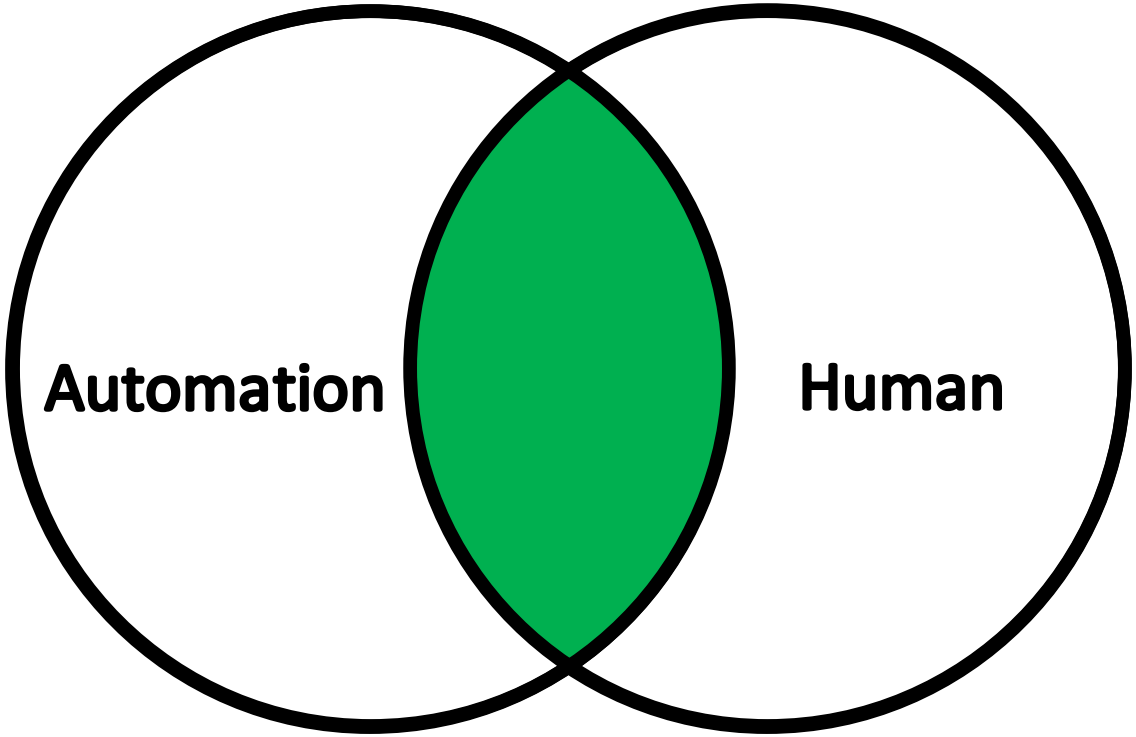


Self-regulated learning: anytime, anywhere

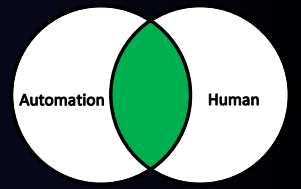
But alone !

How do we teach?

Some of our techniques even involve humans!



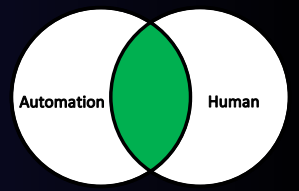
How do we teach?



The teaching of the Mathematics Learning Centre is not limited to on-line material.

- There are dedicated subject-specific workshops to help students with week-to-week study.
- The mainstay of the Mathematics Learning Centre is the drop-in Centre where students can get individual help from teachers and other students.
- Bridging courses.

How do we teach?

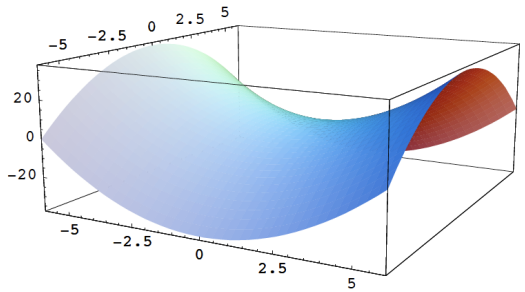


We use mathematical symbolic computer programs to motivate ideas.
For example: Mathematica is used for saddle points and Taylor series.

Computer Algebra Using Mathematica

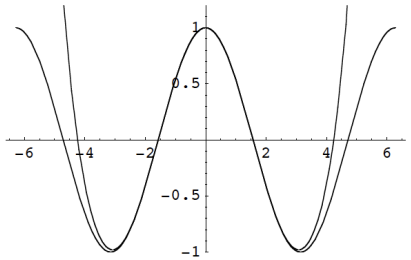
To plot the surface $z(x, y) = x^2 - y^2$ we use :

```
Plot3D[x^2 - y^2, {x, -6, 6}, {y, -6, 6}, PlotPoints → 40, Mesh → False, ViewPoint → {1.3, -2.4, .6}];
```

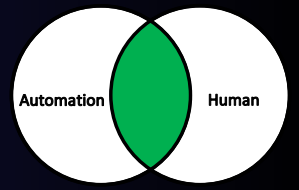


To plot the functions $cos(x)$ and the 8 th order series expansion of $cos(x)$ use :

```
Plot[{Cos[x], 1 - x^2 / 2 + x^4 / 24 - x^6 / 720 + x^8 / 40320}, {x, -2 * Pi, 2 * Pi}, PlotRange → {-1, 1.2}]
```

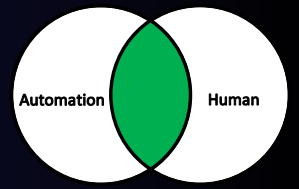


Blended Learning



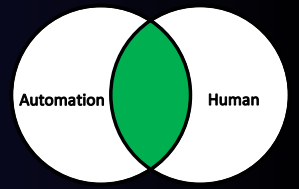
Blended Learning is the
“range of possibilities presented by combining internet and digital media with established classroom forms that require the physical co-presence of teacher and student” (Friesen 2012)

But



Can students “self-regulate” effectively?

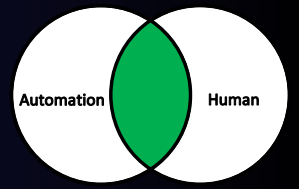
But



Not knowing what they don't know.

- Gaps in mathematical knowledge can be unforgiving
- Without timely intervention can be overwhelming
- Higher attrition rates for online and for math (Ashby et al. 2011, Smith & Ferguson 2005)

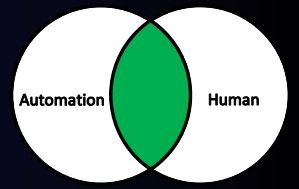
But



Being satisfied with what they don't know.

- Some avoid engaging with more than a superficial level
- A screencasts-only diet can make this easier to do
- Example: 'spoonfeedme.com.au'
- Can lead to "ritualized learning" or "mimicry" (Meyer & Shanahan 2003), or to superficial learning (Loch & Borland 2014)

But

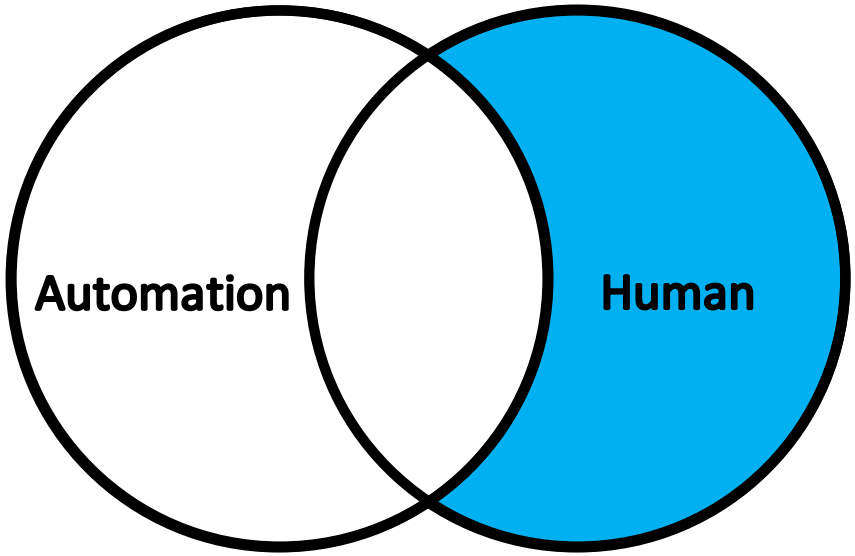


Knowing the wrong thing.

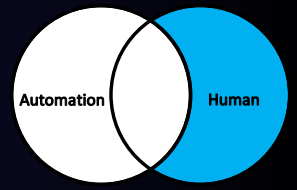
- Errors in understanding
- Example $f''(x) = 0$ necessary but not *sufficient* for inflection points.
- Videos often teach with single line of thought
- Misconceptions can be more entrenched through screencast use (Muller 2008)

Human aspects

Question:
What aspects of teaching **mathematics** cannot (yet?) be replaced by automated delivery?



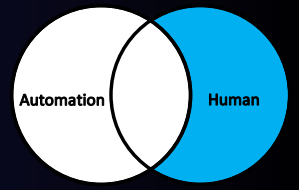
Human aspects



Social aspects

- Community sense of belonging, sense of value, forge life long bonds.
- Create, develop knowledge socially (Paechter & Maier 2010)
- Motivation - “positive interpersonal relationship” with instructor (Paechter & Maier 2010)
  Encouragement - resilience and courage to “push on”, positive reinforcement
- A safe environment - to express misunderstandings, fears, doubts; to focus on misconceptions and errors. Online channels can be intimidating (Galligan et al. 2012)
  We can reinforce the idea that making mistakes can be not only OK, but can be a fruitful and perhaps even necessary part of learning.

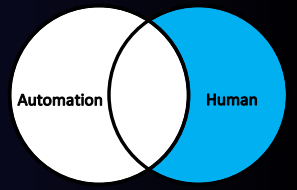
Human aspects



Adaptive, agile, responsive, innovative

- Assess if someone actually needs help with mathematics: do we need to address some other issue first? We can help to alleviate, and manage anxiety, distress, even phobias
- We can identify what needs to be addressed. For example what a student may need to catch up on.
- We can reconcile students' ideas and prior conceptions with more conventional methods. example: We can answer the question: 'Am I right if I do the problem this way?'
- We can change approach if it seems like what we tried initially is not working.
- We can help students who think differently.

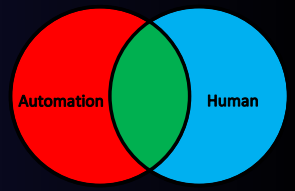
Human aspects

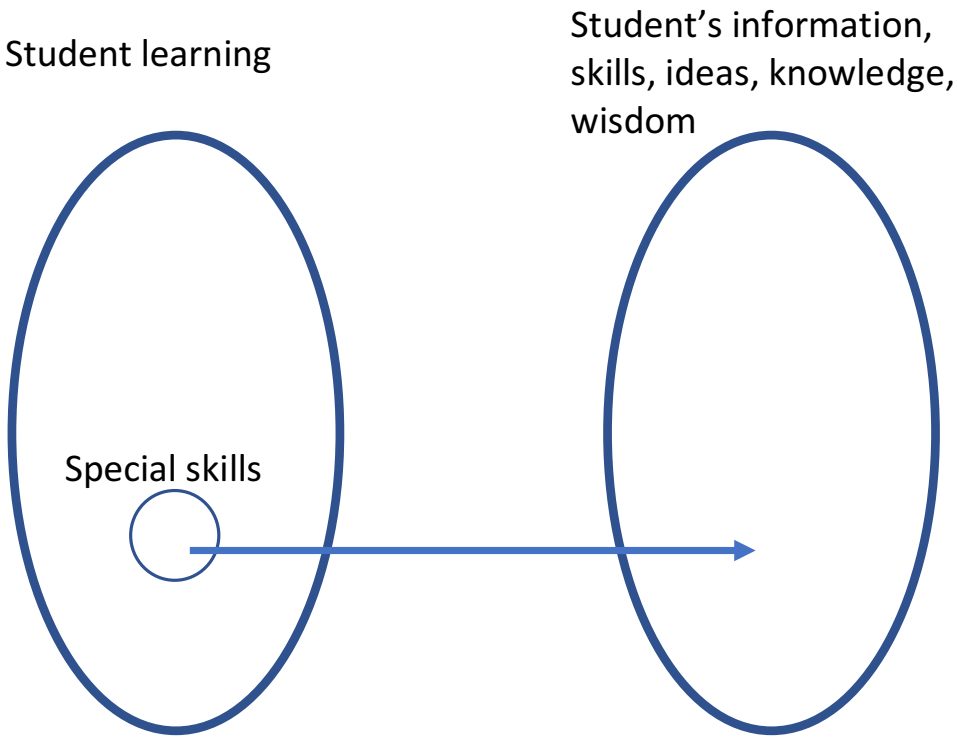


Communication

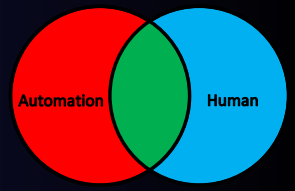
- Co-presence - “thick” with other information (Goodyear 2006)
- Immediate feedback - online is slow turnaround, discussions difficult, symbolic and visual nature of maths (Smith & Ferguson 2005, Loch & Borland 2014)

Mathscasts are a valuable component. But are they sufficient?





Future projects



- Misconceptions in mathematics - address through mathscasts?
- Compare bridging course students - videos (distance students) vs blended & face-to-face (on campus)

References

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