AR Coursework Lecture

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Information

- Demonstrator/TA: Imogen Morris s1402592@ed.ac.uk
- Lab sessions: 4.12, Appleton Tower,
- Submission Deadline: 4pm 18th Nov
- Isabelle 2018 is installed on DICE machines: type 'Isabelle FOO.thy' in the terminal window.
- You should have a look at the recommended reading and try the exercises from the course website.

Coursework Part 1

- Prove some propositional and first-order proofs:
- You may use only the methods

rule	rule_tac	drule
drule_tac	erule	erule_tac
frule	frule_tac	assumption

Coursework Part 1

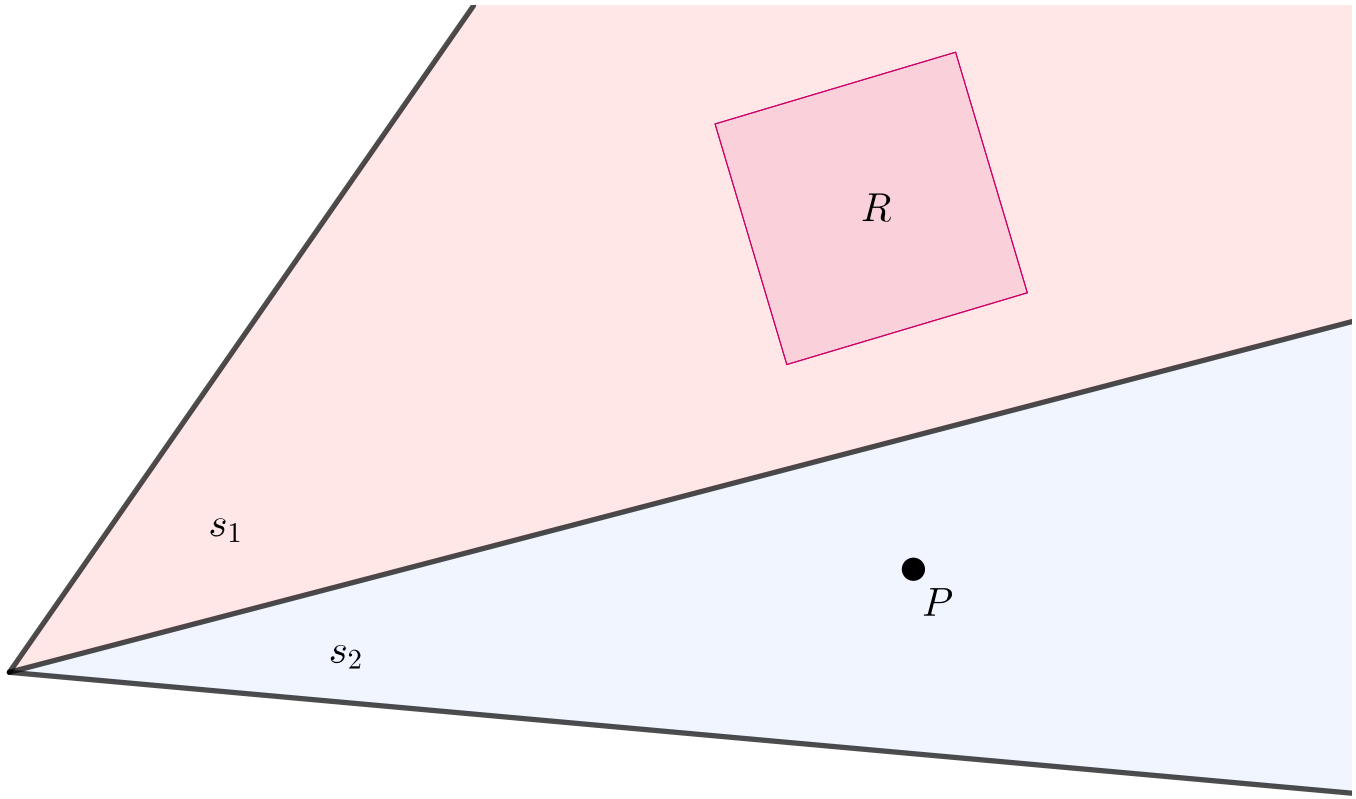
- You may use only the rules:

conjI	conjE	impI
impE	mp	iffI
iffE	notI	notE
disjI1	disjI2	disjE
exI	exE	allI
allE	spec	classical
ccontr		

- No automatic proof methods (auto, blast etc) !

Coursework Part 2

- Formalising a Geometry of Sections (split into 4 locales):
- points, regions, sectors, sections
- incidence
- region_to_section
- R is included in s_1



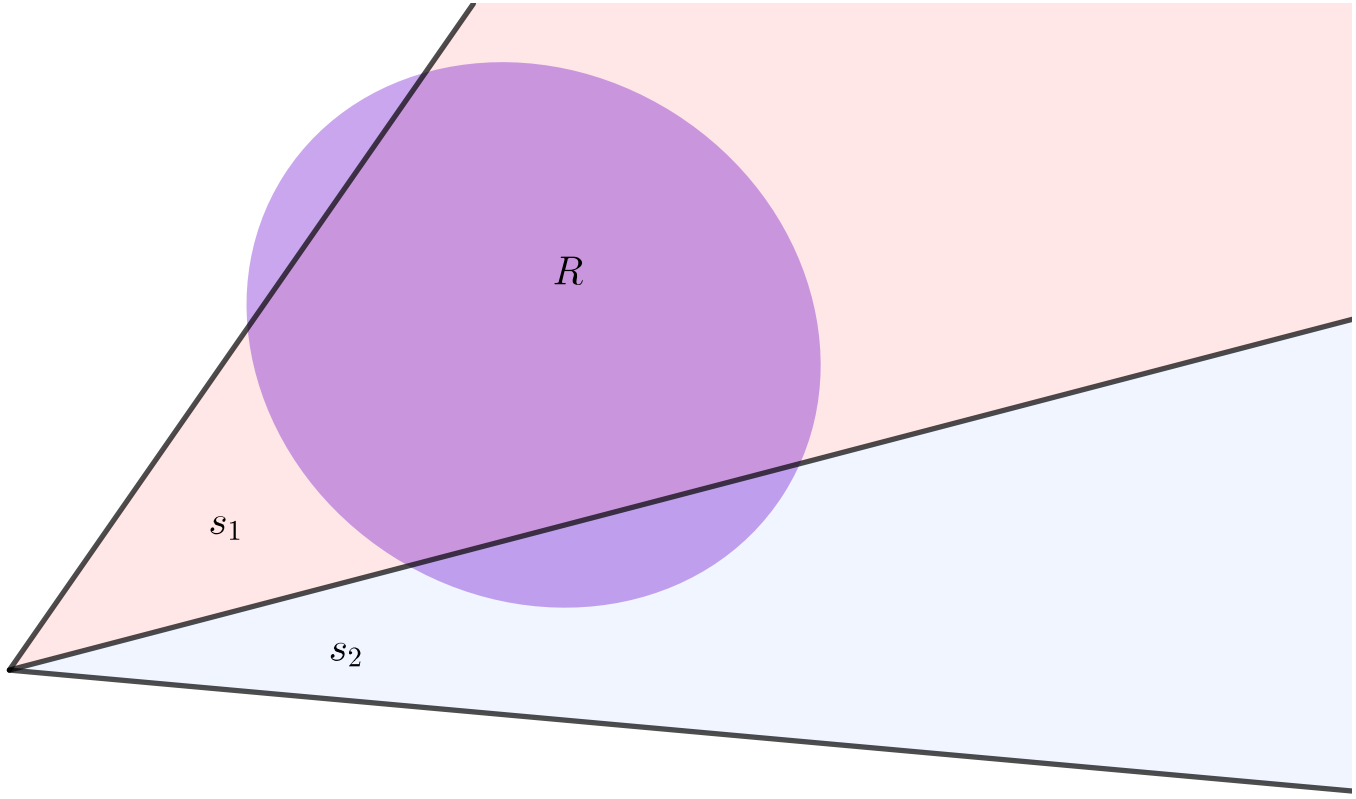
Coursework Part 2

- Split into 4 locales: incidence, section_bundles, comparison, crossing_sector

```
locale section_bundles =  incidence incidence_points_on_sections region_to_section
  for  incidence_points_on_sections :: "'point ⇒ 'section ⇒ bool"
  and region_to_section :: "'region ⇒ 'section" +
  fixes crossing :: "'region ⇒ 'section ⇒ bool"
  and incidence_sections_on_bundles :: "'section ⇒ 'bundle ⇒ bool" (infix "ι_section" 80)
 assumes SC1: (*Write your formalisation of Axiom SC1 here*) (*1 mark*)
 and SI1: (*Write your formalisation of Axiom SI1 here*)     (*1 mark*)
begin
```

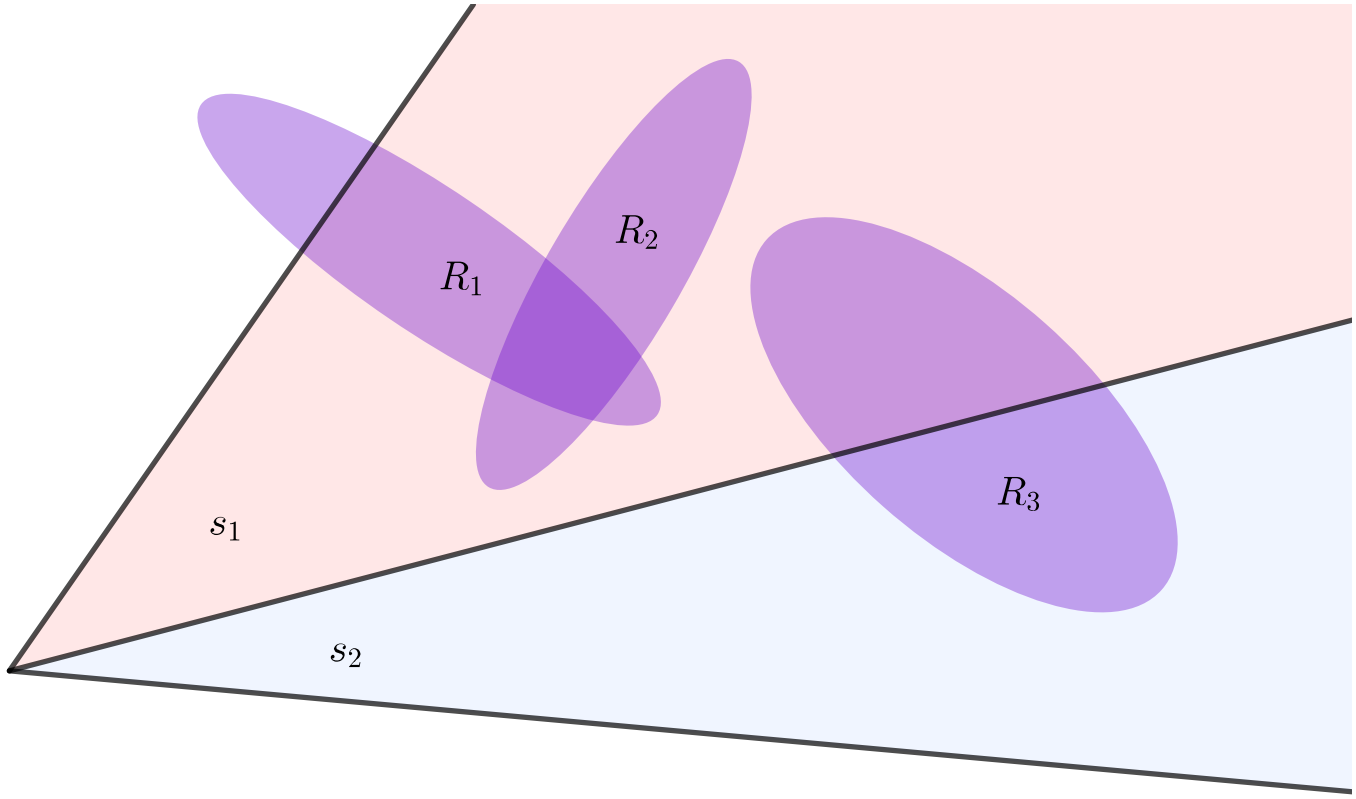
Coursework Part 2

- R crosses s_1
- R overlaps s_1 (Axiom SC1)



Coursework Part 2

$$\geq_{\mathsf{o}} (b, R, R') \Leftrightarrow_{\mathsf{def}} \forall s \, [s \, \iota \, b \Rightarrow (\mathsf{o}(R', s) \Rightarrow \mathsf{o}(R, s))]$$



Coursework Part 2

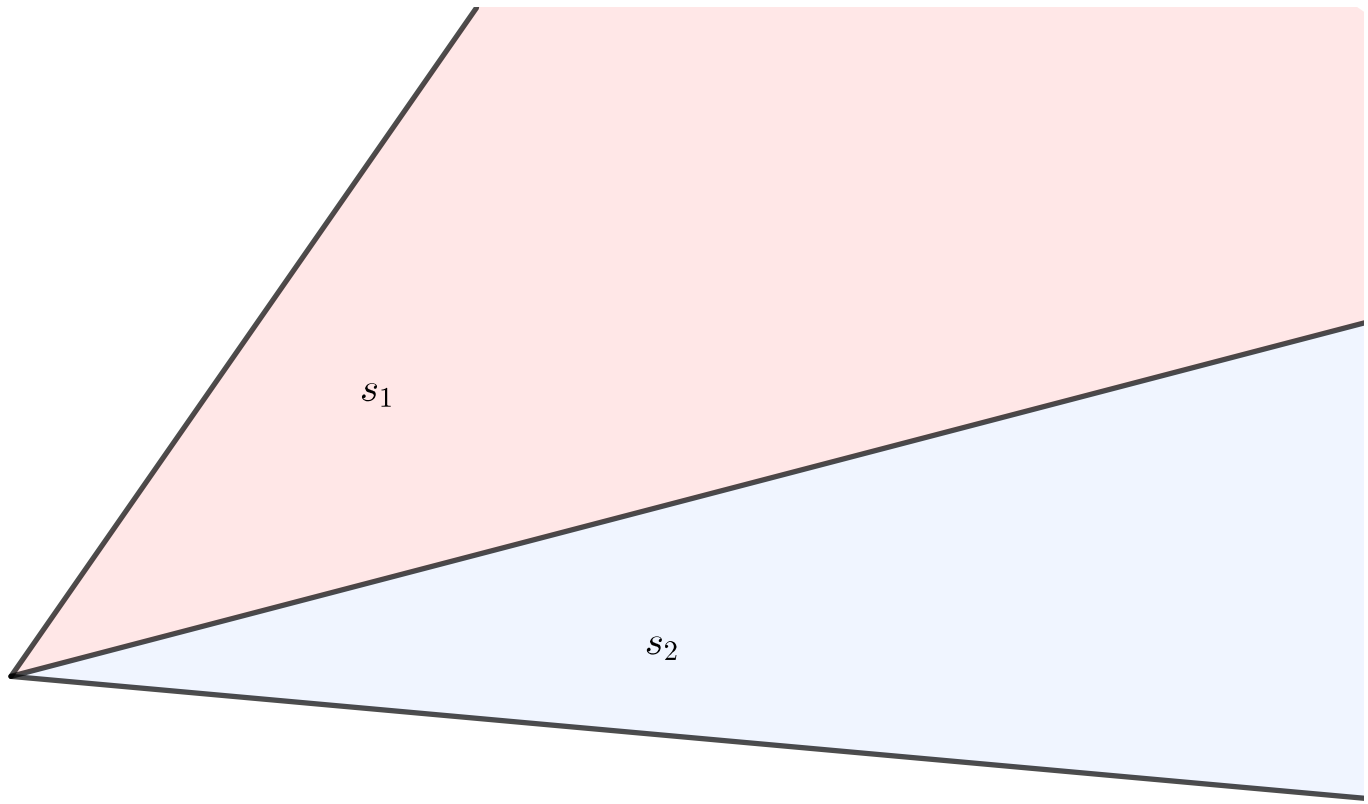
- s is the core of b, $s = \text{core}(b)$ (functional) is represented as s isCoreOf b (relational).
- Functional definitions are assumed to be total.
- But the core of b is not always defined.

Coursework Part 2

- s_1 and s_2 not comparable.

$$\leq (b, s, s') \Leftrightarrow_{\mathsf{def}} s \,\iota\, b \wedge s' \,\iota\, b \wedge s \subseteq s'$$

$$s = \mathsf{core}(\mathsf{b}) \Leftrightarrow_{\mathsf{def}} \mathsf{s} \,\iota\, \mathsf{b} \wedge \forall \mathsf{s}' \,[\mathsf{s}' \,\iota\, \mathsf{b} \Rightarrow \leq (\mathsf{b}, \mathsf{s}, \mathsf{s}')]$$



Coursework Part 2

- Formalise axioms, lemmas, definitions
- For universal quantifiers use meta level not object level e.g. $\forall x.\ P\ x$ can be formalised as $P\ x$ or $\bigwedge x.\ P\ x$. Same for implication.
- Mechanise proofs of theorems: one-line is acceptable unless asked for structured.
- Structured proof should provide an explanation of why theorem is true.

Coursework Part 3

- Everyone can have a go: credit given for partial formalisations that demonstrate progress.
- If proofs are too easy/difficult then check your formalisation of the definitions.
- Kulik et al. give you some hints
  - what theorems might be used
  - phrasing T6-T8 in both symbols and words.
- Prove useful lemmas if you are stuck or overwhelmed.
- You may use any of the Isabelle methods except smt.
- You may invoke Sledgehammer to see if it can provide an automatic justification for any of your proof step.
- Make sure your proofs are properly structured to make the reasoning clear.

Overview

- Deadline: 18th Nov, 4pm
- Refer to recommended reading and self-help exercises for background and help.
- Inbuilt tactics/methods (auto, simp etc.) can be used from Part 2 onwards. Please bear in mind the restrictions mentioned in the handout though.
- Use the 'query' box or search the imported theories (at `https://isabelle.in.tum.de/library/HOL/`) to find theorems
- Break challenging proofs into lemmas.
- Please make use of the TA (and not just before the deadline!).