



CSE 341 Section 1



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Adapted from slides by Josiah Adams, Cody A. Schroeder, and Dan Grossman

Hi, I'm Nicholas **orelse** Nick

- 5th year Masters Student and THIS IS MY LAST QUARTER!!!
- Grew up in California
- Lived in San Francisco before moving to Seattle
- Talk to me any time about Movies, Music, Video Games
- Can also talk to me about CSE 341

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Today's Agenda

- ML Development Workflow
 - Emacs
 - Using **use**
 - The REPL
- More ML
 - Shadowing Variables
 - Debugging Tips
 - Boolean Operations
 - Comparison Operations

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Emacs

- Recommended (not required) editor for this course
- Powerful, but the learning curve can at first be intimidating
- Helpful resources
 - [CSE 341 Emacs Guide](#)
 - Google it!
 - /r/emacs [Foot Pedals???](#)
 - Course staff, or ask around in the labs

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Quick Emacs Demo



Image credit: <http://earlcolour.deviantart.com/art/emacs-user-at-work-195326745>

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Using **use**

```
use "foo.sml";
```

- Enters bindings from the file **foo.sml**
 - Like typing the variable bindings one at a time in sequential order into the REPL (more on this in a moment)
- Result is **()** bound to variable **it**
 - Ignorable

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The REPL

- Read-Eval-Print-Loop is well named
- Conveniently run programs: **C-c C-s**
 - Useful to quickly try something out
 - Save code for reuse by moving it into a persistent .sml file
- Expects semicolons
- For reasons discussed later, it's dangerous to reuse **use** without restarting the REPL session
 - End the REPL session with **C-d**

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Shadowing of Variable Bindings

```
val a = 1; (* a -> 1 *)
val b = a * 10; (* a -> 1, b -> 10 *)
val a = 2; (* a -> 2, b -> 10 *)
```

- Expressions in variable bindings are evaluated “eagerly”
 - Before the variable binding “finishes”
 - Afterwards, the expression producing the value is irrelevant
- Multiple variable bindings to the same variable name, or “**shadowing**”, is allowed
 - When looking up a variable, ML uses the most recent binding by that name in the current environment
- Remember, there is no way to “assign to” a variable in ML
 - Can only **shadow** it in a later environment
 - After binding, a variable's value is an immutable constant

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Try to Avoid Shadowing

```
val x = "Hello World";
val x = 2; (* is this a type error? *)
val res = x * 2; (* is this 4 or a type error? *)
```

- Shadowing can be confusing and is often poor style
- Why? Reintroducing variable bindings in the same REPL session may..
 - make it seem like *wrong* code is *correct*; or
 - make it seem like *correct* code is *wrong*.

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Using a Shadowed Variable

- Is it ever possible to use a shadowed variable? **Yes!**
And no...
- It can be possible to uncover a shadowed variable when the latest binding goes out of scope

```
val x = "Hello World";
fun add1(x : int) = x + 1; (* shadow x in func body *)
val y = add1 2;
val z = x ^ "!!!"; (* "Hello World!!!" *)
```

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Use **use** Wisely

- **Warning:** Variable shadowing makes it dangerous to call **use** more than once without *restarting* the REPL session.
- It **may** be fine to repeatedly call **use** in the same REPL session, but unless you know what you're doing, *be safe!*
 - Ex: loading multiple distinct files (with independent variable bindings) at the beginning of a session
 - The behavior of **use** is well-defined, but even expert programmers can get confused
- Restart your REPL session before repeated calls to **use**

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Debugging Errors

Your mistake could be:

- Syntax: What you wrote means nothing or not the construct you intended
- Type-checking: What you wrote does not type-check
- Evaluation: It runs but produces wrong answer, or an exception, or an infinite loop

Keep these straight when debugging even if sometimes one kind of mistake appears to be another

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Play Around

Best way to learn something: Try lots of things and don't be afraid of errors

Work on developing resilience to mistakes

- Slow down
- Don't panic
- Read what you wrote very carefully

Maybe watching me make a few mistakes will help...

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Boolean Operations

Operation	Syntax	Type-checking	Evaluation
<code>andalso</code>	<code>e1 andalso e2</code>	<code>e1</code> and <code>e2</code> must have type <code>bool</code>	Same as Java's <code>e1 && e2</code>
<code>orelse</code>	<code>e1 orelse e2</code>	<code>e1</code> and <code>e2</code> must have type <code>bool</code>	Same as Java's <code>e1 e2</code>
<code>not</code>	<code>not e1</code>	<code>e1</code> must have type <code>bool</code>	Same as Java's <code>!e1</code>

- `not` is just a pre-defined function, but `andalso` and `orelse` must be built-in operations since they cannot be implemented as a function in ML.
 - Why? Because `andalso` and `orelse` “short-circuit” their evaluation and may not evaluate both `e1` and `e2`.
- Be careful to always use `andalso` instead of `and`.
- `and` is completely different. We will get back to it later.

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Style with Booleans

Language does not *need* `andalso`, `orelse`, or `not`

```
(* e1 andalso e2 *)
if e1
then e2
else false

(* e1 orelse e2 *)
if e1
then true
else e2

(* not e1 *)
if e1
then false
else true
```

Using more concise forms generally much better style

And definitely please do not do this:

```
(* just say e (!!!) *)
if e
then true
else false
```

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Comparisons

For comparing `int` values:

`=` `<>` `>` `<` `>=` `<=`

You might see weird error messages because comparators can be used with some other types too:

- `>` `<` `>=` `<=` can be used with `real`, but not a mixture of 1 `int` and 1 `real`
- `=` `<>` can be used with any “equality type” but not with `real`
 - Let's not discuss equality types yet

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