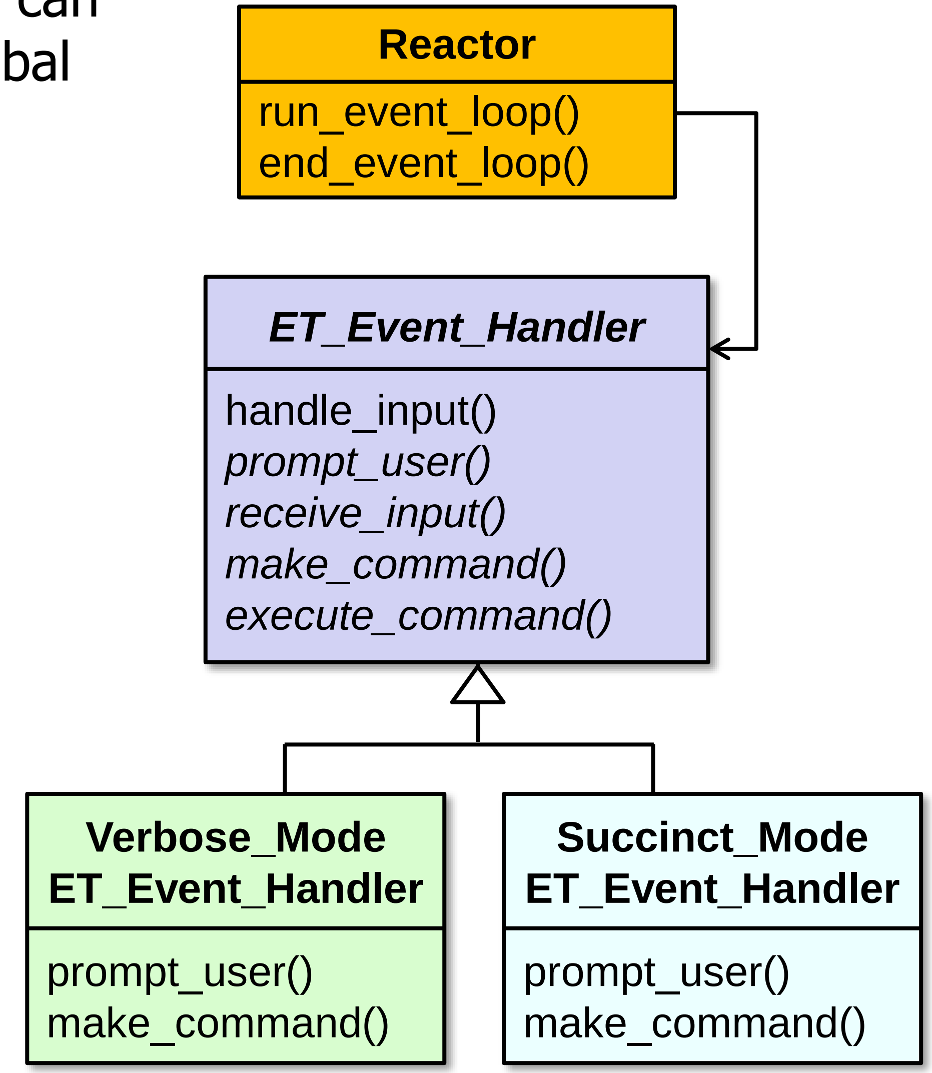
The Singleton Pattern

Motivating Example

Douglas C. Schmidt

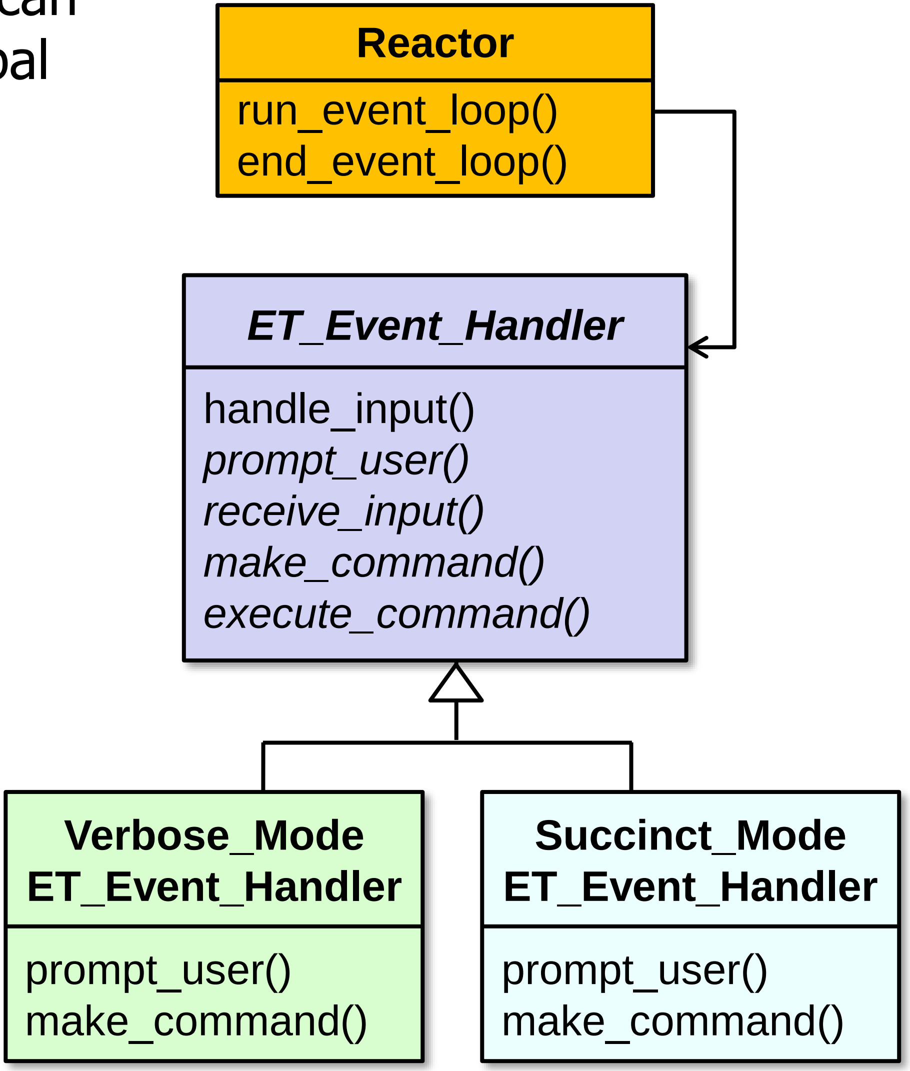
Learning Objectives in This Lesson

- Recognize how the *Singleton* pattern can be applied to centralize access to global resources in the expression tree processing app.



Learning Objectives in This Lesson

- Recognize how the *Singleton* pattern can be applied to centralize access to global resources.



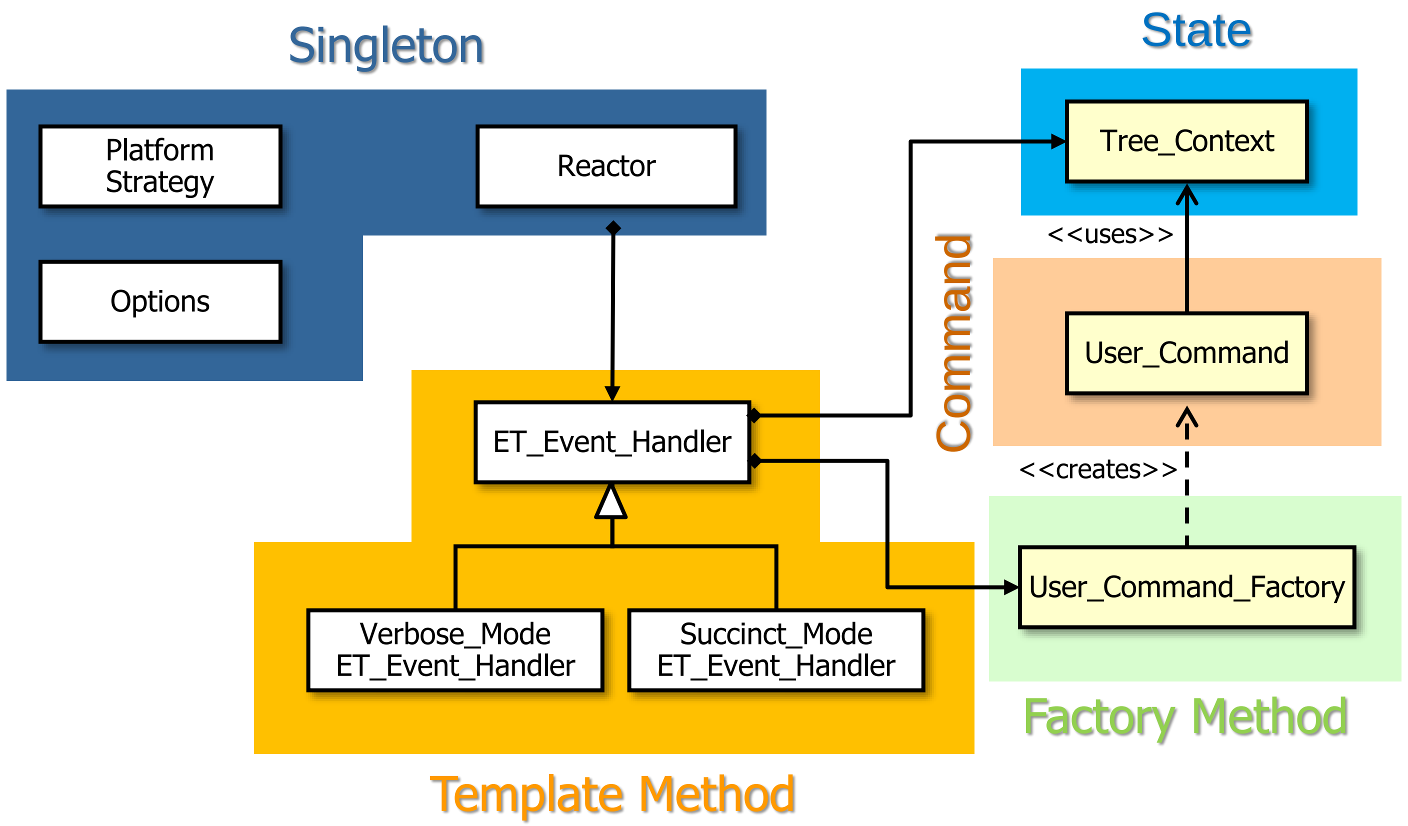
See en.wikipedia.org/wiki/Robot_B-9

Douglas C. Schmidt

Motivating the Need for the Singleton Pattern in the Expression Tree App

A Pattern for Centralizing Global Resource Access

***Purpose**: Simplify access to global resources without using global variables.*



The *Singleton* pattern has well-known drawbacks, so apply it with care.

Context: OO Expression Tree Processing App

- Only one instance of certain classes are needed

```
int main (int argc, char *argv[]) {
  unique_ptr<Options> options
    (Options::instance ());

  if (!options->parse_args (argc, argv))
    return 0;

  unique_ptr<Reactor> reactor
    (Reactor::instance ());

  reactor->register_input_handler
    (ET_Event_Handler::make_handler
      (options->verbose ()));

  reactor->run_event_loop ();

  return 0;
}
```

Context: OO Expression Tree Processing App

- Only one instance of certain classes are needed, e.g.,
  - Command-line options that determine the app operating mode

```
int main (int argc, char *argv[]) {
  unique_ptr<Options> options
    (Options::instance ());

  if (!options->parse_args (argc, argv))
    return 0;

  unique_ptr<Reactor> reactor
    (Reactor::instance ());

  reactor->register_input_handler
    (ET_Event_Handler::make_handler
      (options->verbose ()));

  reactor->run_event_loop ();

  return 0;
}
```

Context: OO Expression Tree Processing App

- Only one instance of certain classes are needed, e.g.,
  - Command-line options that determine the app operating mode
  - Reactor that drives the expression tree input handling

```
int main (int argc, char *argv[]) {
  unique_ptr<Options> options
    (Options::instance ());

  if (!options->parse_args (argc, argv))
    return 0;

  unique_ptr<Reactor> reactor
    (Reactor::instance ());

  reactor->register_input_handler
    (ET_Event_Handler::make_handler
      (options->verbose ()));

  reactor->run_event_loop ();

  return 0;
}
```

Context: OO Expression Tree Processing App

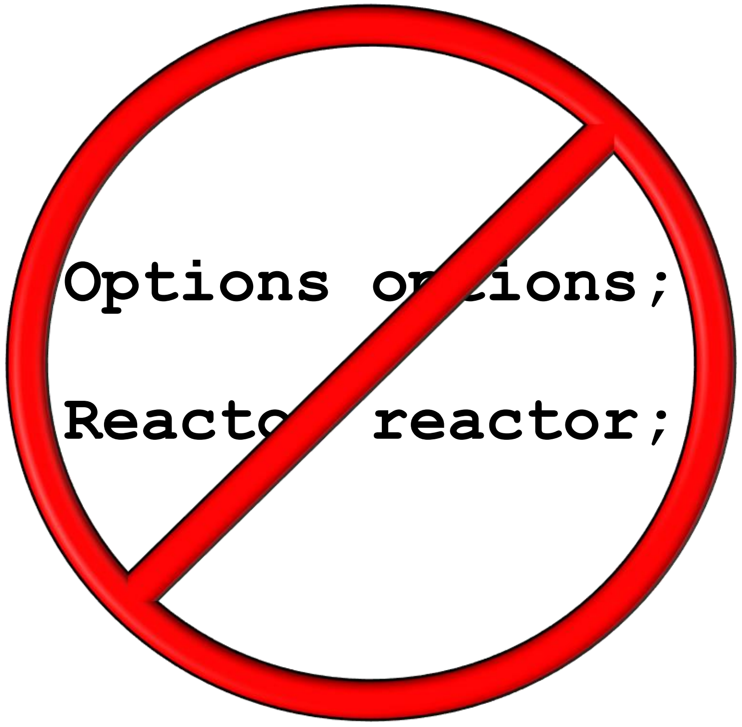
- Only one instance of certain classes are needed, e.g.,
  - Command-line options that determine the app operating mode
  - Reactor that drives the expression tree input handling

```
int main (int argc, char *argv[]) {
  unique_ptr<Options> options
    (Options::instance ());

  if (!options->parse_args (argc, argv))
    return 0;

  unique_ptr<Reactor> reactor
    (Reactor::instance ());

  reactor->register_input_handler
    (ET_Event_Handler::make_handler
      (options->verbose ()));

  reactor->run_event_loop ();

  return 0;
}
```

Passing these objects as parameters can become tedious & "cluttered."

Problem: Minimizing Global Variable Liabilities

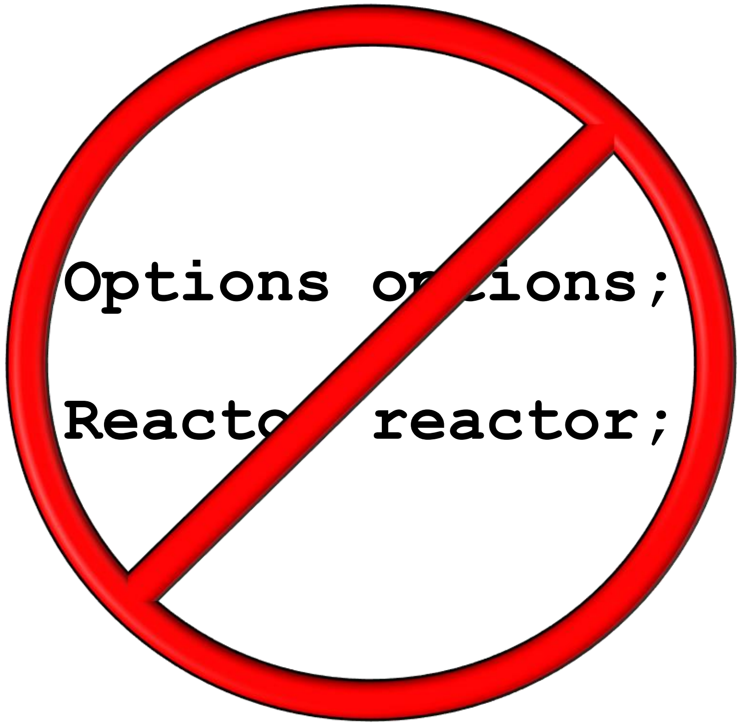
- Global variables are problematic for several reasons.
  - Increase implicit dependencies & reduce program clarity
  - Incur time/space overhead even if they aren't used
  - Cannot be extended transparently
  - May not be initialized & destroyed properly in certain programming languages & runtime environments



See wiki.c2.com/?GlobalVariablesConsideredHarmful

Problem: Minimizing Global Variable Liabilities

- Global variables are problematic for several reasons.
  - Increase implicit dependencies & reduce program clarity
  - Incur time/space overhead even if they aren’t used
  - Cannot be extended transparently
  - May not be initialized & destroyed properly in certain programming languages & runtime environments



This discussion wouldn’t address all liabilities with global variables.

Solution: Centralize Access to Global Resources

- Create a central access point to global resources *without* using a global variable.

```
int main (int argc, char *argv[]) {


  unique_ptr<Options> options(Options::instance ());

  if (!options->parse_args (argc, argv))
    return 0;

  unique_ptr<Reactor> reactor(Reactor::instance ());

  reactor->register_input_handler
    (ET_Event_Handler::make_handler(options->verbose ()));

  reactor->run_event_loop ();

  return 0;
}
```

Solution: Centralize Access to Global Resources

- Create a central access point to global resources *without* using a global variable.

Allocate object on demand & parse common-line options

```
int main (int argc, char *argv[]) {

  unique_ptr<Options> options(Options::instance ());

  if (!options->parse_args (argc, argv))
    return 0;

  unique_ptr<Reactor> reactor(Reactor::instance ());

  reactor->register_input_handler
    (ET_Event_Handler::make_handler(options->verbose ()));

  reactor->run_event_loop ();

  return 0;
}
```

Solution: Centralize Access to Global Resources

- Create a central access point to global resources *without* using a global variable.

```
int main (int argc, char *argv[]) {


  unique_ptr<Options> options(Options::instance ());

  if (!options->parse_args (argc, argv))
    return 0;

  unique_ptr<Reactor> reactor(Reactor::instance ());

  reactor->register_input_handler
    (ET_Event_Handler::make_handler(options->verbose ()));

  reactor->run_event_loop ();

  return 0;
}
```

Create a Reactor singleton to process input events

Solution: Centralize Access to Global Resources

- Create a central access point to global resources *without* using a global variable.

```
int main (int argc, char *argv[]) {


  unique_ptr<Options> options(Options::instance ());

  if (!options->parse_args (argc, argv))
    return 0;

  unique_ptr<Reactor> reactor(Reactor::instance ());

  reactor->register_input_handler
    (ET_Event_Handler::make_handler(options->verbose ()));

  reactor->run_event_loop ();

  return 0;
}
```

Allocate/register requested ET_Event_Handler based on command-line options

Solution: Centralize Access to Global Resources

- Create a central access point to global resources *without* using a global variable.

```
int main (int argc, char *argv[]) {


  unique_ptr<Options> options(Options::instance ());

  if (!options->parse_args (argc, argv))
    return 0;

  unique_ptr<Reactor> reactor(Reactor::instance ());

  reactor->register_input_handler
    (ET_Event_Handler::make_handler(options->verbose ()));

  reactor->run_event_loop ();

  return 0;
}
```

Reactor processes user input via callbacks