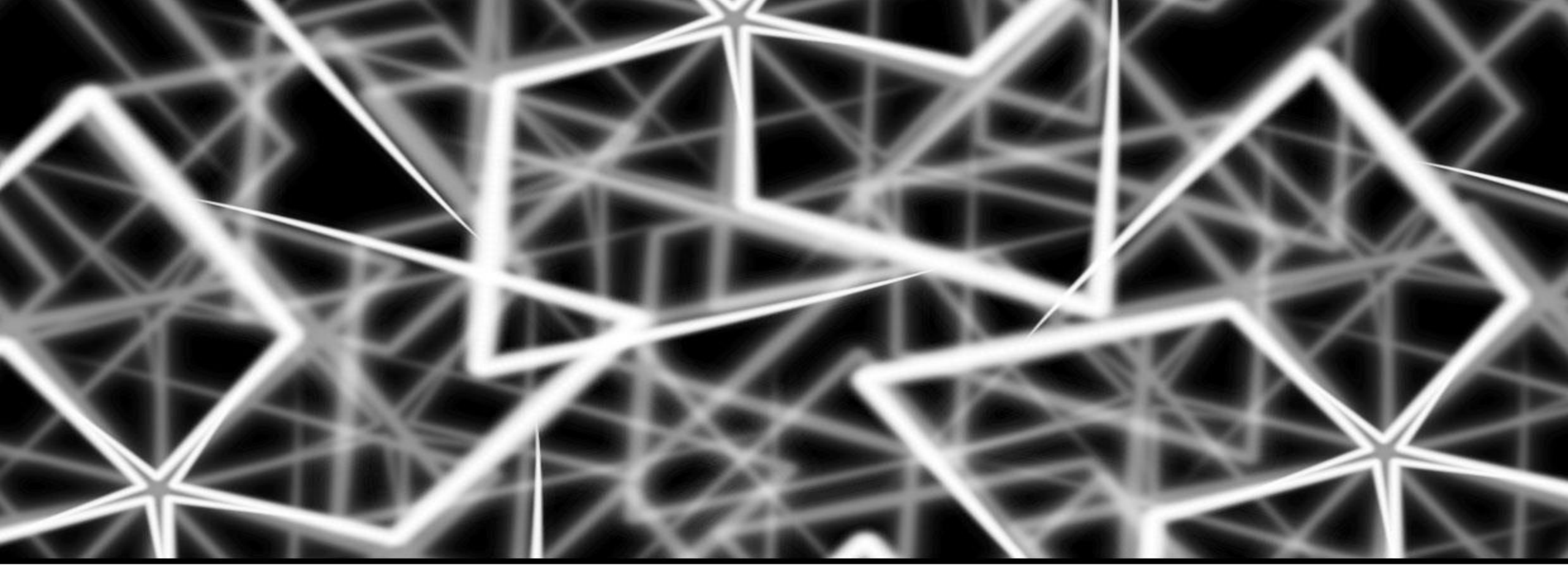

Lecture # 17

State Space Explosion

STATE SPACE EXPLOSION

```
MODULE main
VAR
     x:  boolean;
```

Transition system of above NuSMV program has 2 states

`x=FALSE` and `x=TRUE`

STATE SPACE EXPLOSION

```
MODULE main
VAR
     x:  boolean;
     y:  boolean;
```

Transition system of above NuSMV program has 4 states

x=FALSE	x=FALSE	x=TRUE	x=TRUE
y=FALSE	y=TRUE	y=FALSE	y=TRUE

STATE SPACE EXPLOSION

```
MODULE main
VAR
     x:  boolean;
     y:  boolean;
     input:  sys();

MODULE sys()
VAR
     state:  { s1, s2, s3, s4, s5 };
```

Transition system of above NuSMV program has $2 * 2 * 5$ states

STATE SPACE EXPLOSION

If NuSMV program has 10 **boolean variables**, transition system will have 2^{10} states!

If NuSMV program has 10 **module variables**, each of which has 10 states, the transition system will have 10^{10} states!

Tackling state space explosion

- **Efficient data structures:** Binary Decision Diagrams
- **Abstraction:** Interpret model with fewer variables relevant to property
- **Partial order reduction:** for asynchronous systems, combining several interleavings
- **Composition:** Break verification into simpler verification problem
- **Bounded model-checking:** Unroll transition system upto a fixed length of paths