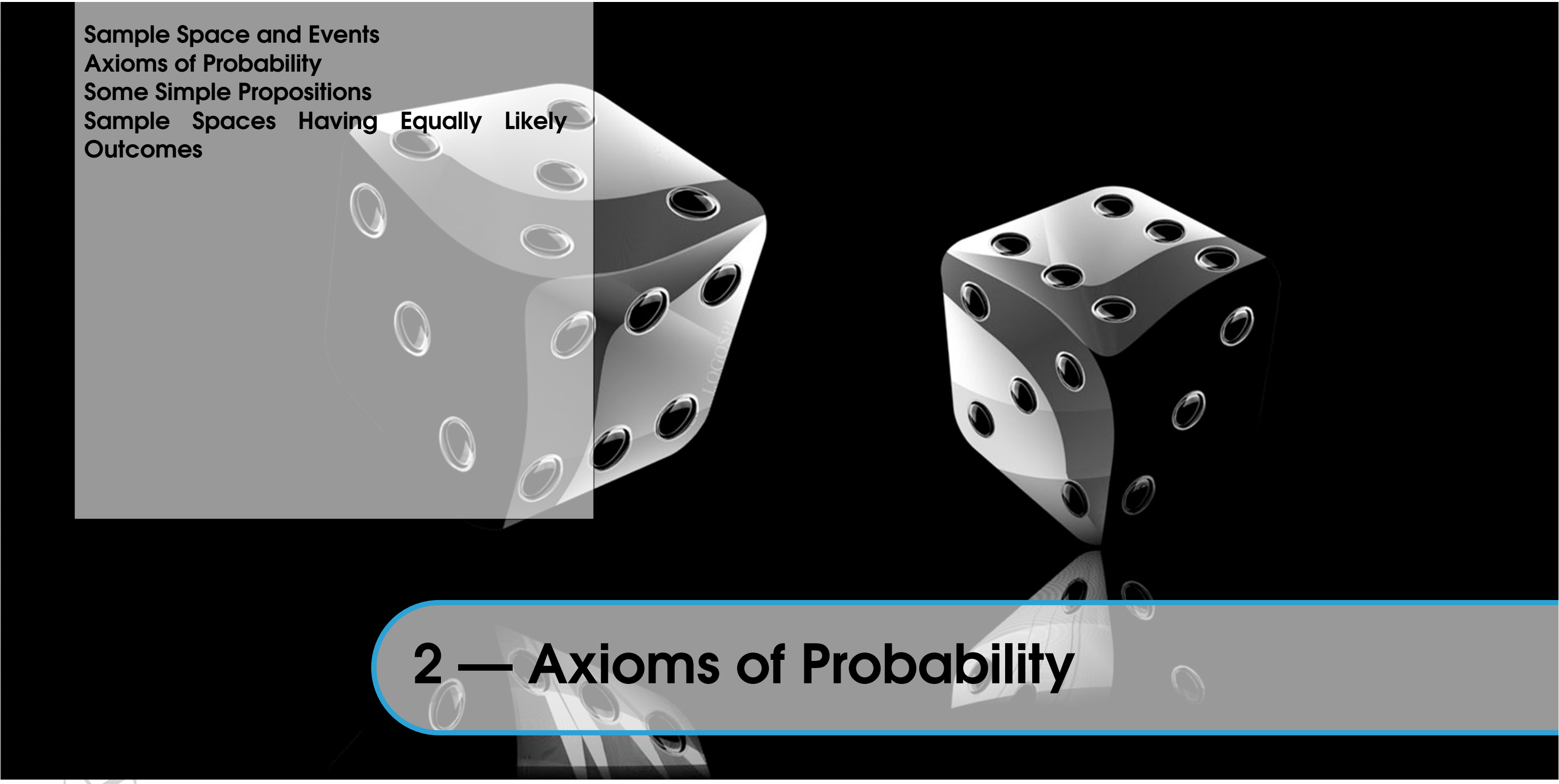

2 — Axioms of Probability

2.2 Sample Space and Events

First consider an experiment. What is the main terminology that we use when we properly study this experiment?

- Sample Space: The set of all possible outcomes (denoted, usually, by S,)
- Event: Any subset of the sample space (denoted, usually, by $E, F, G, \ldots.$)

■ **Example 2.1** Experiment: Roll a dice once

- Sample Space: $S = \{1,2,3,4,5,6\}$
- Some events:
  - $E = \{\text{an even number shows}\} = \{2,4,6\}$
  - $F = \{1,6\}$
  - $F = \{2,3,5,6\}$

■

■ **Example 2.2** Experiment: Sex of a newborn baby

- Sample Space: $S = \{b, g\}$ (b=boy, g=girl)
- Some event:
  - $E = \{b, g\}$
  - $F = \emptyset$
  - $F = \{b\}$

■

■ **Example 2.3** Experiment: Measuring lifetime of a bulb (in hours)

- Sample Space: $S = [0, \infty)$
- Some event:
  - $E = \{2\}$
  - $F = (1,3]$
  - $F = (10, \infty)$

■

It's a good time to review your knowledge on the definitions of set operations such as

$$E \cap F, E \cup F, E - F, E \subset F, E^c.$$

Definition 2.2.1 E and F are called mutually exclusive if

$$E \cap F = \emptyset.$$

■ **Example 2.4** Experiment: Roll a dice. Consider two events:
- $E = \{2,4,6\}$
- $F = \{1,3\}$

They are mutually exclusive. ■

Let's recall some properties of set operation:
- $E \cup F = F \cup E$ and $E \cap F = F \cap E$
- $(E \cup F) \cup G = E \cup (F \cup G)$
- $(E \cup F) \cap G = (E \cap G) \cup (F \cap G)$
- $(E \cap F) \cup G = (E \cup G) \cap (F \cup G)$
- De Morgan Laws:
  - $\left(\bigcup_{i=1}^{n} E_i\right)^c = \bigcap_{i=1}^{n} E_i^c$
  - $\left(\bigcap_{i=1}^{n} E_i\right)^c = \bigcup_{i=1}^{n} E_i^c$