Midterm: likely on 10/11 or 11/06 Fall 560 → spring 561/562

What is a robot?

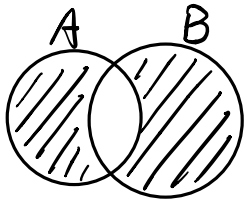
A robot is an autonomous machine handling repetitive/complex tasks.

sensing - computing - control

Mathmetic foundation

A set is a collection of elements.

n-dimentional Euclidean spaces. $\mathbb{R}^n$



symmetric difference: $A \ominus B = A \cup B - A \cap B$

powerset: $\mathcal{P}(S) = \{A \mid A \subset S\}$

E.g. $S = \{1, 2\}$ $\mathcal{P}(S) = \{\emptyset, \{1\}, \{2\}, \{1,2\}\}$

A function is surjective if $f(X) = Y$. E.g. $\mathbb{R} \to \mathbb{R}^+ \cup \{0\}$, $x \mapsto x^2$

injective $\forall x_1 \neq x_2$, $f(x_1) \neq f(x_2)$

bijective it's ~~both~~ surjective and injective.

In general, the size of $\mathcal{P}(S)$ is $|\mathcal{P}(S)| = 2^{|S|}$

If $|A| \leq |B|$ and $|A| \geq |B|$, then $|A| = |B|$ useful when trying to prove equality.

A set X and a collection Γ of subsets (called open sets) of X form a topological space if:

- $\emptyset \in \Gamma$ and $X \in \Gamma$
- Arbitrary union ($\cup$) of elements of Γ is again in Γ.
- Finite intersection ($\cap$) of elements of Γ is again in Γ.

E.g. $\Gamma = \{\emptyset, \{1\}, \{2\}, \{1,2\}, \{1,2,3\}\}$

$\{\emptyset, \{1,2\}, \{2,3\}, \{1,2,3\}\}$

$\{1,2\} \cap \{2,3\} = \{2\} \notin \Gamma$

A set is closed if $(X - A)$ is open.

One can build a series of homeomorphisms to deform between two objects, ~~there~~ is.

F_t, $t \in [0, 1]$, is a bijective continuous function with domain X.

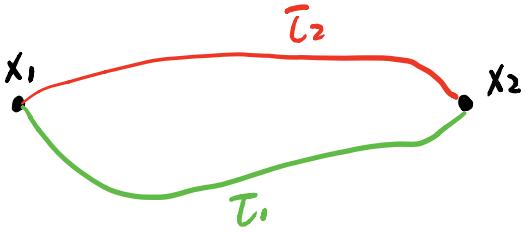
$F_0(x) = X$. $F_1(x) = Y$ F_x, $x \in [0, 1]$ here is known as deformation.

classic example: coffee mug $\Longleftrightarrow$ donut

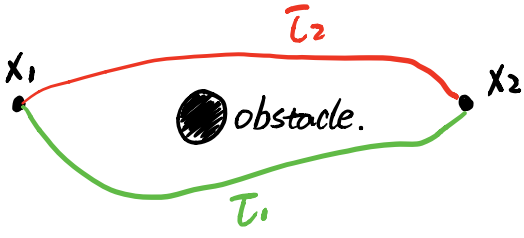
Simply connected space

A topological space X is simply connected if $\forall x_1, x_2 \in X$ and any τ_1, τ_2 with $\tau_1(0) = \tau_2(0) = x_1$ and $\tau_1(1) = \tau_2(1) = x_2$, τ_1 and τ_2 are homotopic. Otherwise, X is multiply connected.

↖ Do not understand!



↑ simply connected



↑ multiply connected.