occur.

More formal ~~xxxx~~ description: Suppose V is a vector space over a field, k. The projective space, $P(V)$, of V is the set of equivalence classes of $V^* = V \setminus \{0\}$ under the equivalence relation: $v, w \in V$, $v \sim w$ if $\exists\, \lambda \in k^* = k \setminus \{0\}$ such that $v = \lambda w$. Clearly $v \sim v$ $(\lambda = 1)$ and if $v \sim w$, then $w \sim v$ (change λ to $\frac{1}{\lambda}$). For transitivity, multiply the λ's involved. You can think of $P(V)$ as the set of directions through the origin in V.

For us (in the confluence of analysis & geometry) the important fields are $\mathbb{R}$ or $\mathbb{C}$, although it should be noted that applications in algebra or combinatorics frequently consider $k =$ a finite field.

The most standard examples in topology occur when $V = \mathbb{R}^{n+1}$ ~~or~~ ($\mathbb{C}^{n+1}$, resp.) and $P(V)$ is called $\mathbb{R}P^n$ ~~xx~~ ($\mathbb{C}P^n$, resp.), real (resp. complex) projective n-space.

~~If~~ $(z_0, \ldots, z_n) \in \mathbb{C}^{n+1*}$ ($\mathbb{R}^{n+1*}$), we'll ~~xxxx~~ let $[z_0 : z_1 : \ldots : z_n]$ denote the equivalence class of $(z_0, \ldots, z_n)$. The numbers $z_0, \ldots, z_n$ are called homogeneous coordinates of the equivalence class.

$\mathbb{R}P^n$ and $\mathbb{C}P^n$ are both topologized spaces, with the quotient topology inherited from $\mathbb{R}^{n+1*}$ and $\mathbb{C}^{n+1*}$.