Thesis title

Your name

Month Year

A thesis submitted for the degree of Doctor of Philosophy
of the Australian National University

For someone or something or whatever

Declaration

The work in this thesis is my own except where otherwise stated.

Your name

Acknowledgements

Abstract

Contents

Notation and terminology

Some preliminary description here? Eg, "In the following, G is a group, H is a subgroup of G, ..."

Notation

notation	definition text goes here definition text goes here definition text goes here
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Terminology

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Chapter 1

Background

Eilenberg and Steenrod inspired the following axiomatic definition of a cohomology theory, intending to capture the nice properties of ordinary cohomology [123123].

Definition 1.1. An ordinary cohomology theory is a sequence of functors E^i for $i \geq 0$ mapping a pair of spaces (X, A) to an abelian group $E^i(X, A)$, as well as natural maps $\delta_i : E^i(A, \emptyset) \to E^{i+1}(X, A)$ satisfying the following axioms:

1. given two homotopic maps $f \simeq g : (X, A) \to (Y, B)$ the induced maps on cohomology groups is the same

2. To any pair (X, A) there is an associated long exact sequence:

$$\cdots \longrightarrow E^i(X, A) \xrightarrow{q_*} E^i(X, \emptyset) \xrightarrow{i_*} E^i(A, \emptyset) \xrightarrow{\delta_i} E^{i+1}(X, A) \longrightarrow \cdots$$

   where i_* and q_* are the maps induced by the inclusions $i : (A, \emptyset) \to (X, \emptyset)$ and $q : (X, \emptyset) \to (X, A)$

3. (*Excision*) Given any subspace $U \subset A \subset X$ then the inclusion of $(X \setminus U, A \setminus U)$ into (X, A) induces an isomorphism on cohomology groups

$$E^i(X, A) \xrightarrow{i_*} E^i(X \setminus U, A \setminus U)$$

4. (*Additivity*) If (X, A) is the disjoint union of subsets $\{(X_j, A_j)\}_{j \in J}$ then we get the following isomorphism for all i:

$$E^i(X, A) \xrightarrow{\sim} \prod_{j \in J} E^i(X_j, A_j)$$

5. (*dimension*) $E^i(pt) = 0$ for all $i > 0$.

Let us drop the cumbersome notation $E^i(X, \emptyset)$ and simply write $E^i(X)$ instead.

Unfortunately this definition (in particular the dimension axiom) is quite restrictive and it excludes many nice functors we might like to think of as cohomology theories, such as topological K-theory which has $K^{2i}(pt) \cong K^0(pt) \cong \mathbb{Z}$ for all $i \in \mathbb{Z}$. The next definition tries to rectify this problem:

Definition 1.2. A *generalised cohomology theory* is a sequence of functors E^i with maps δ_i all as above which satisfies axioms 1-4 of *Definition 1.1*.

Let us now consider a particular set of generalised cohomology theories with rather nice nice properties.

Definition 1.3. A generalised cohomology theory E is called an *even periodic ring theory* if it satisfies the following properties:

1. $E^*(pt)$ is a commutative ring

2. $E^i(pt) = 0$ whenever i is odd

3. there exists elements $\beta \in E^2(pt)$ and $\beta^{-1} \in E^{-2}(pt)$ such that $\beta\beta^{-1} = 1$ in $E^*(pt)$

The obvious example is once again K-theory. Indeed the properties in *Definition 1.3* follow since $K^*(pt) \cong \mathbb{Z}[\alpha, \alpha^{-1}]$ where $\alpha \in K^2(pt)$

Appendix A

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Bibliography

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