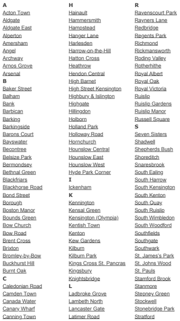
What is topology?

Jon Woolf

February, 2010

Set of tube stations



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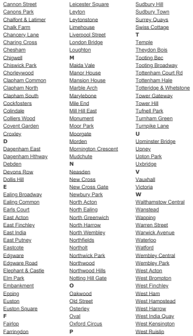
Aldgate
Aldgate East
Alperton
Amersham
Angel
Archway
Arnos Grove
Arsenal
B
Baker Street
Balham
Bank
Barbican
Barking
Barkingside
Barons Court
Bayswater
Becontree
Belsize Park
Bermondsey
Bethnal Green
Blackfriars
Blackhorse Road
Bond Street
Borough
Boston Manor
Bounds Green
Bow Church
Bow Road
Brent Cross
Brixton
Bromley-by-Bow
Buckhurst Hill
Burnt Oak
C
Caledonian Road
Camden Town
Canada Water
Canary Wharf
Canning Town

H
Hainault
Hammersmith
Hampstead
Hanger Lane
Harlesden
Harrow-on-the-Hill
Hatton Cross
Heathrow
Hendon Central
High Barnet
High Street Kensington
Highbury & Islington
Highgate
Hillingdon
Holborn
Holland Park
Holloway Road
Hornchurch
Hounslow Central
Hounslow East
Hounslow West
Hyde Park Corner
I
Ickenham
K
Kennington
Kensal Green
Kensington (Olympia)
Kentish Town
Kenton
Kew Gardens
Kilburn
Kilburn Park
Kings Cross St. Pancras
Kingsbury
Knightsbridge
L
Ladbroke Grove
Lambeth North
Lancaster Gate
Latimer Road

R
Ravenscourt Park
Rayners Lane
Redbridge
Regents Park
Richmond
Rickmansworth
Roding Valley
Rotherhithe
Royal Albert
Royal Oak
Royal Victoria
Ruislip
Ruislip Gardens
Ruislip Manor
Russell Square
S
Seven Sisters
Shadwell
Shepherds Bush
Shoreditch
Snaresbrook
South Ealing
South Harrow
South Kensington
South Kenton
South Quay
South Ruislip
South Wimbledon
South Woodford
Southfields
Southgate
Southwark
St. James's Park
St. Johns Wood
St. Pauls
Stamford Brook
Stanmore
Stepney Green
Stockwell
Stonebridge Park
Stratford



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Canons Park
Chalfont & Latimer
Chalk Farm
Chancery Lane
Charing Cross
Chesham
Chigwell
Chiswick Park
Chorleywood
Clapham Common
Clapham North
Clapham South
Cockfosters
Colindale
Colliers Wood
Covent Garden
Croxley
D
Dagenham East
Dagenham Hthway
Debden
Devons Row
Dollis Hill
E
Ealing Broadway
Ealing Common
Earls Court
East Acton
East Finchley
East India
East Putney
Eastcote
Edgware
Edgware Road
Elephant & Castle
Elm Park
Embankment
Epping
Euston
Euston Square
F
Fairlop
Farringdon

Leicester Square
Leyton
Leytonstone
Limehouse
Liverpool Street
London Bridge
Loughton
M
Maida Vale
Manor House
Mansion House
Marble Arch
Marylebone
Mile End
Mill Hill East
Monument
Moor Park
Moorgate
Morden
Mornington Crescent
Mudchute
N
Neasden
New Cross
New Cross Gate
Newbury Park
North Acton
North Ealing
North Greenwich
North Harrow
North Wembley
Northfields
Northolt
Northwick Park
Northwood
Northwood Hills
Notting Hill Gate
O
Oakwood
Old Street
Osterley
Oval
Oxford Circus
P

Sudbury Hill
Sudbury Town
Surrey Quays
Swiss Cottage
T
Temple
Theydon Bois
Tooting Bec
Tooting Broadway
Tottenham Court Rd
Tottenham Hale
Totteridge & Whetstone
Tower Gateway
Tower Hill
Tufnell Park
Turnham Green
Turnpike Lane
U
Upminster Bridge
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Upton Park
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Vauxhall
Victoria
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Walthamstow Central
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Wapping
Warren Street
Warwick Avenue
Waterloo
Watford
Wembley Central
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West Acton
West Brompton
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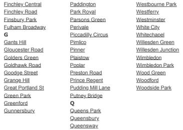
West Ham
West Hampstead
West Harrow
West India Quay
West Kensington
West Ruislip

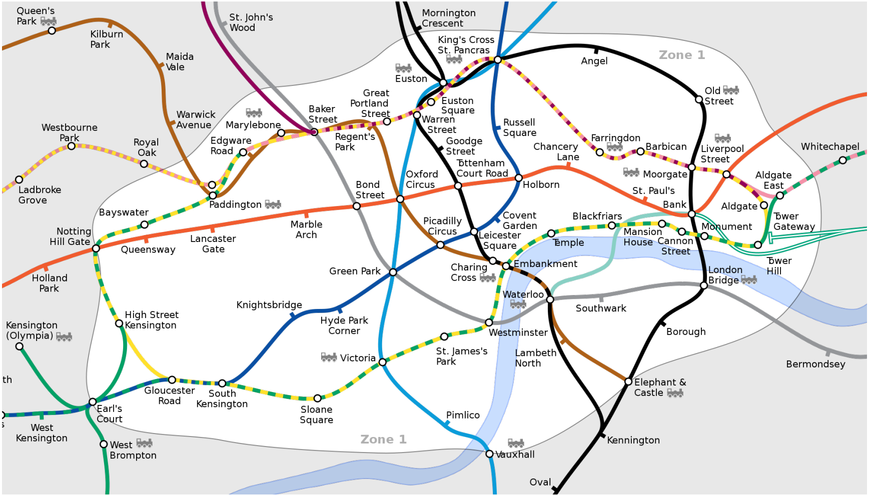


Finchley Central
Finchley Road
Finsbury Park
Fulham Broadway
G
Gants Hill
Gloucester Road
Golders Green
Goldhawk Road
Goodge Street
Grange Hill
Great Portland St
Green Park
Greenford
Gunnersbury

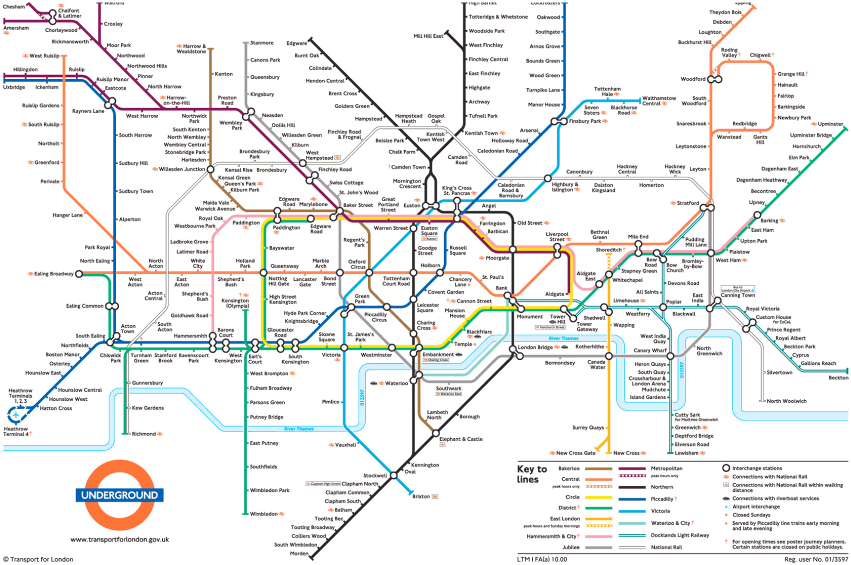
Paddington
Park Royal
Parsons Green
Perivale
Piccadilly Circus
Pimlico
Pinner
Plaistow
Poplar
Preston Road
Prince Regent
Pudding Mill Lane
Putney Bridge
Q
Queens Park
Queensbury
Queensway

Westbourne Park
Westferry
Westminster
White City
Whitechapel
Willesden Green
Willesden Junction
Wimbledon
Wimbledon Park
Wood Green
Woodford
Woodside Park

Geometric map of the tube


Queen's Park
Kilburn Park
Maida Vale
St. John's Wood
Mornington Crescent
King's Cross St. Pancras
Euston
Angel
Zone 1
Old Street
Warwick Avenue
Westbourne Park
Royal Oak
Marylebone
Baker Street
Great Portland Street
Euston Square
Warren Street
Russell Square
Regent's Park
Edgware Road
Goodge Street
Farringdon
Barbican
Chancery Lane
Liverpool Street
Whitechapel
Ladbroke Grove
Tottenham Court Road
Moorgate
Aldgate East
Paddington
Bond Street
Oxford Circus
Holborn
St. Paul's
Bank
Aldgate
Bayswater
Marble Arch
Picadilly Circus
Covent Garden
Blackfriars
Tower Gateway
Notting Hill Gate
Queensway
Lancaster Gate
Leicester Square
Temple
Mansion House
Cannon Street
Monument
Embankment
Tower Hill
Green Park
Charing Cross
London Bridge
Holland Park
Waterloo
Knightsbridge
Southwark
Hyde Park Corner
High Street Kensington
Westminster
Borough
Kensington (Olympia)
Victoria
St. James's Park
Lambeth North
Bermondsey
Elephant & Castle
th
Gloucester Road
South Kensington
Earl's Court
Sloane Square
Pimlico
West Kensington
West Brompton
Zone 1
Vauxhall
Kennington
Oval

Topological map of the tube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Pinner
North Harrow
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West Ruislip
Ruislip
Ruislip Manor
Eastcote
Hillingdon
Uxbridge
Ickenham
Ruislip Gardens
Rayners Lane
South Ruislip
West Harrow
South Harrow
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Greenford
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Perivale
Sudbury Town
Hanger Lane
Alperton
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Ealing Common
North Acton
West Acton
East Acton
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Acton Town
South Ealing
Northfields
Boston Manor
Osterley
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Hounslow Central
Hounslow West
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Heathrow Terminals 1, 2, 3
Heathrow Terminal 4
Chiswick Park
Turnham Green
Stamford Brook
Ravenscourt Park
Gunnersbury
Kew Gardens
Richmond
South Acton
Harrow & Wealdstone
Kenton
Preston Road
Northwick Park
South Kenton
North Wembley
Wembley Central
Stonebridge Park
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Willesden Junction
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Kentish Town
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Barking
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Tower Gateway
Fenchurch Street
Shadwell
Limehouse
Westferry
All Saints
Devons Road
Poplar
East India
Blackwall
Canning Town
Bus to London City Airport
Royal Victoria
Custom House for ExCeL
Prince Regent
Royal Albert
Beckton Park
Cyprus
Gallions Reach
Beckton
Silvertown
North Woolwich
West India Quay
Canary Wharf
Heron Quays
South Quay
Crossharbour & London Arena
Mudchute
Island Gardens
North Greenwich
Cutty Sark for Maritime Greenwich
Greenwich
Deptford Bridge
Elverson Road
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West Brompton
Fulham Broadway
Parsons Green
Putney Bridge
East Putney
Southfields
Wimbledon Park
Wimbledon
River Thames
Key to lines
Bakerloo
Central
peak hours only
Circle
District †
East London
peak hours and Sunday mornings
Hammersmith & City †
Jubilee
Metropolitan
peak hours only
Northern
Piccadilly †
Victoria
Waterloo & City †
Docklands Light Railway
National Rail
Interchange stations
Connections with National Rail
Connections with National Rail within walking distance
Connections with riverboat services
Airport interchange
Closed Sundays
Served by Piccadilly line trains early morning and late evening
† For opening times see poster journey planners. Certain stations are closed on public holidays.
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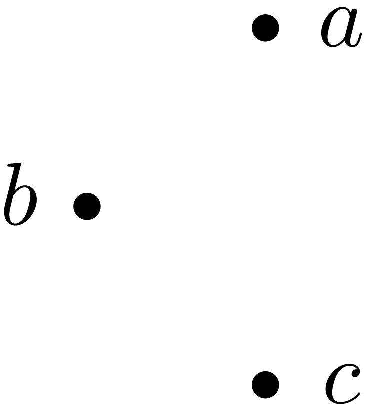
Spaces from sets with relations



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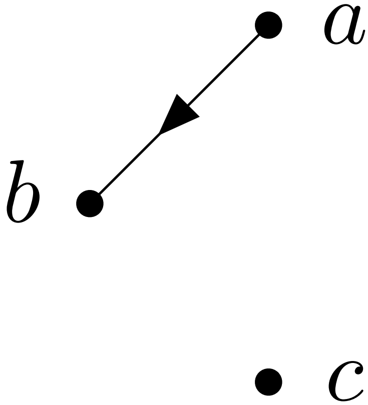

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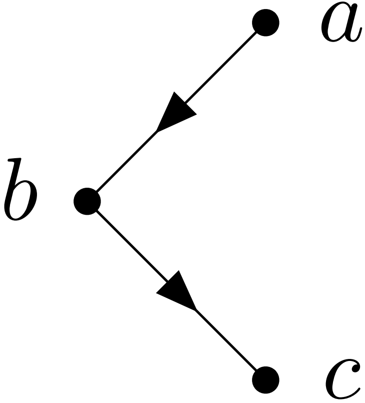

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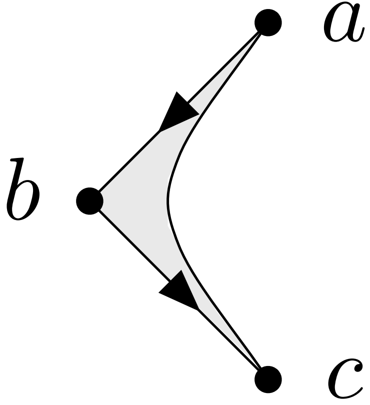

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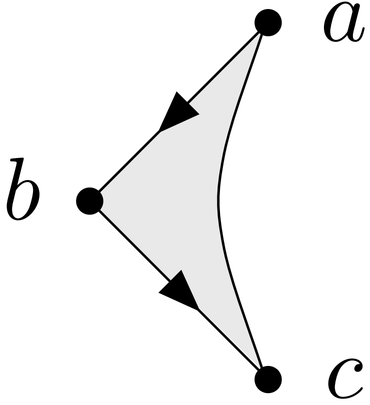

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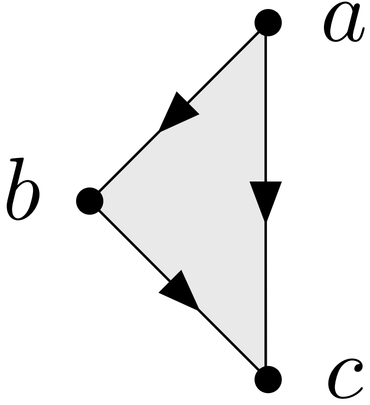

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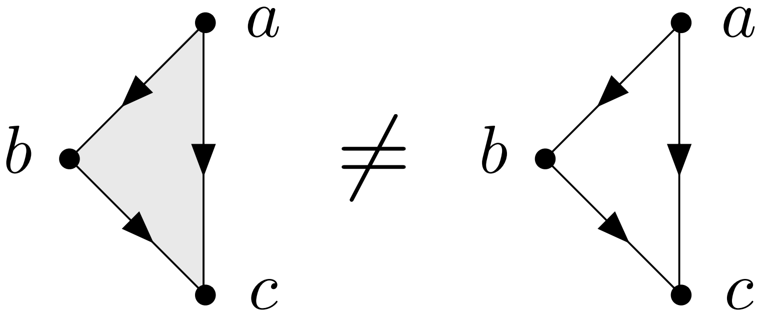

Spaces as sets with relations, with relations,. . .

This construction of spaces from sets with relations is very general.

Spaces as sets with relations, with relations,. . .

This construction of spaces from sets with relations is very general.
In a sense, all spaces arise in this way.

Spaces as sets with relations, with relations,. . .

This construction of spaces from sets with relations is very general. In a sense, all spaces arise in this way.

The points of a space form a set,

Spaces as sets with relations, with relations,. . .

This construction of spaces from sets with relations is very general. In a sense, all spaces arise in this way.

The points of a space form a set, paths in the space are relations between the start and end points.

Spaces as sets with relations, with relations,. . .

This construction of spaces from sets with relations is very general. In a sense, all spaces arise in this way.

The points of a space form a set, paths in the space are relations between the start and end points. A deformation of one path into another is a relation between relations.

Spaces as sets with relations, with relations,. . .

This construction of spaces from sets with relations is very general. In a sense, all spaces arise in this way.

The points of a space form a set, paths in the space are relations between the start and end points. A deformation of one path into another is a relation between relations. And so on through higher and higher relations.

Spaces as sets with relations, with relations,. . .

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The points of a space form a set, paths in the space are relations between the start and end points. A deformation of one path into another is a relation between relations. And so on through higher and higher relations.

In this way we build a set with relations, and relations between relations and so on *ad infinitum* out of a space.

Spaces as sets with relations, with relations,. . .

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In this way we build a set with relations, and relations between relations and so on *ad infinitum* out of a space. We can turn this set with relations etc back into a space using the previous construction.

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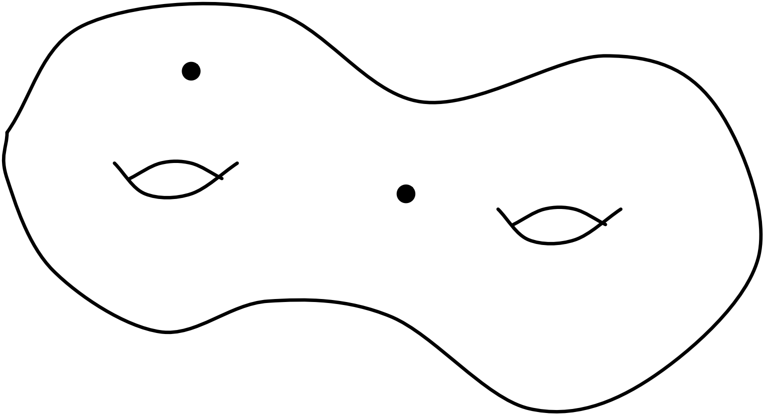
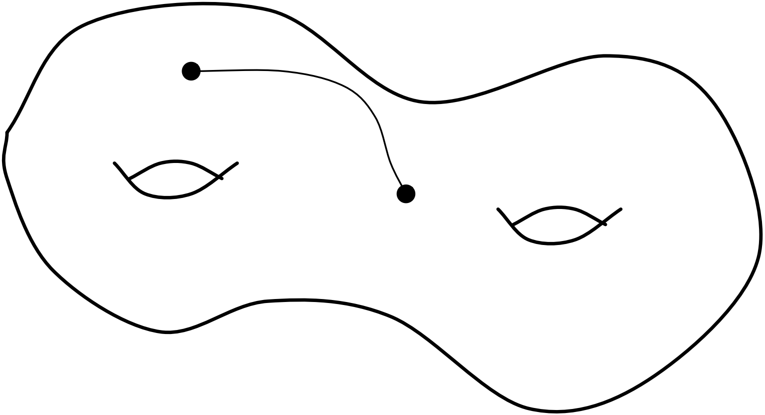
The points of a space form a set, paths in the space are relations between the start and end points. A deformation of one path into another is a relation between relations. And so on through higher and higher relations.

In this way we build a set with relations, and relations between relations and so on *ad infinitum* out of a space. We can turn this set with relations etc back into a space using the previous construction. The resulting space is ‘equivalent’ to the original one.

Homotopy theory



Homotopy theory



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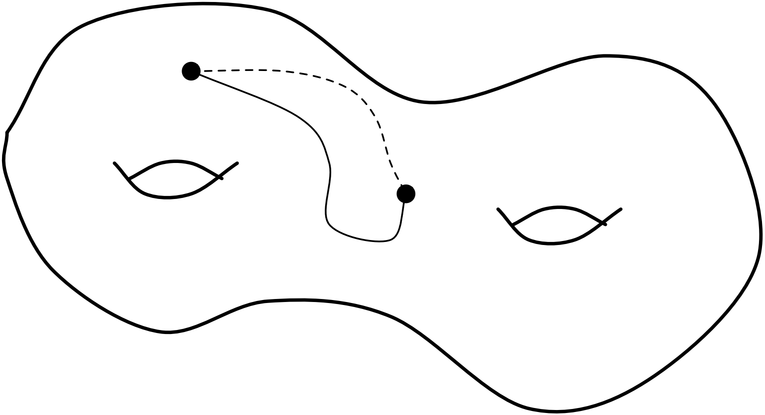

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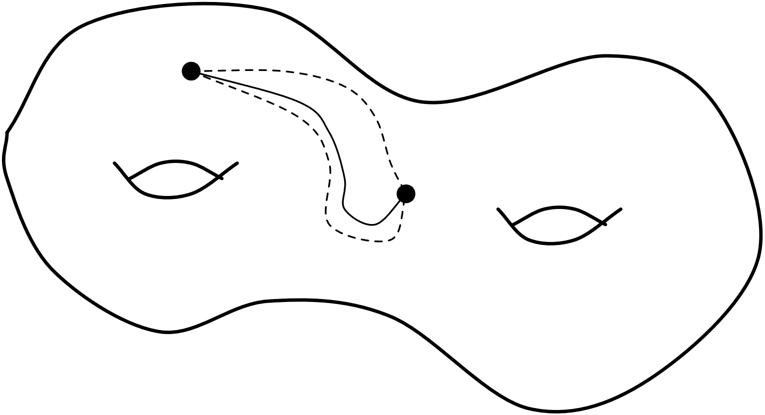
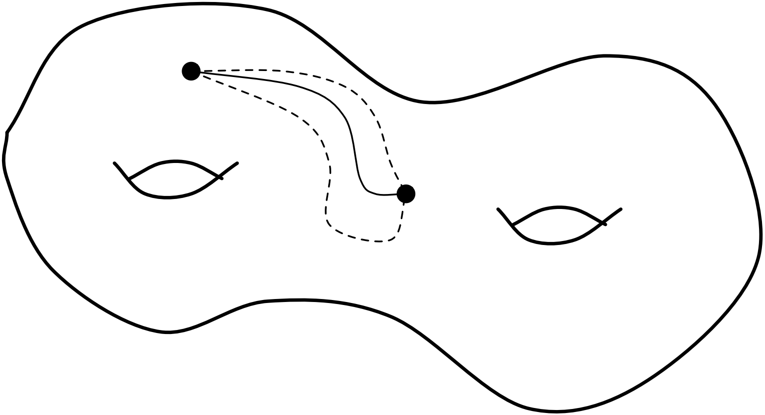


Homotopy theory



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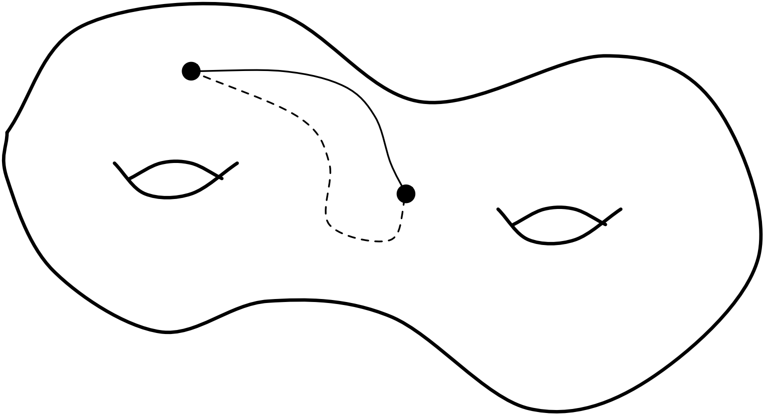

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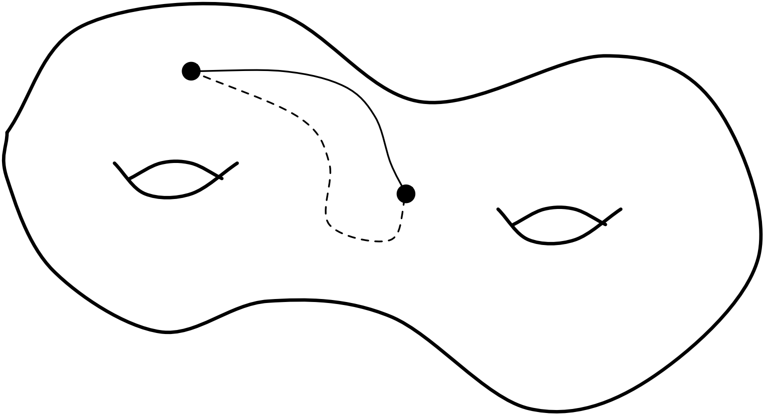

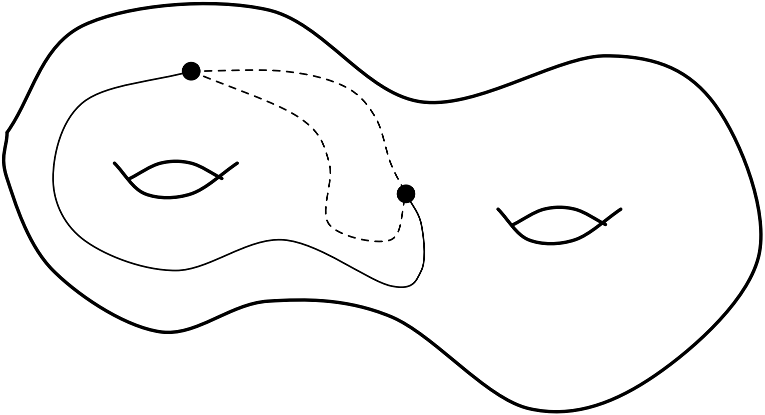Homotopy theory