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and contains
four core
topics. The
first two topics
surround active
areas that have
been outstanding
from the birth
of discrete
geometry, namely
dense sphere

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*packings and
tilings. Sphere
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very strong
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*it is also
connected to
some other*

*important
research areas
as the one on
coverings by
planks (with
close ties to
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topic is
discussed under*

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which, with its
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the beginning of
the mathematical
sciences. Thus,
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surprisingly,
geometry has

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role in many
important
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*mathematics, or
equivalently,
the broad
movement to
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called discrete
geometry. One
can briefly
describe this
branch of

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*Groups arise
naturally as*

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*symmetries of
geometric
objects, and so
groups can be
used to
understand
geometry and
topology.*

*Conversely, one
can study
abstract groups
by using
geometric
techniques and*

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*ultimately by
treating groups
themselves as
geometric
objects. This
book explores
these
connections
between group
theory and
geometry,
introducing some
of the main
ideas of*

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*transformation
groups,
algebraic
topology, and
geometric group
theory. The
first half of
the book
introduces basic
notions of group
theory and
studies symmetry
groups in
various*

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*geometries,
including
Euclidean,
projective, and
hyperbolic. The
classification
of Euclidean
isometries leads
to results on
regular
polyhedra and
polytopes; the
study of
symmetry groups*

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using matrices
leads to Lie
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groups and Lie
algebras. The
second half of
the book
explores ideas
from algebraic
topology and
geometric group
theory. The
fundamental
group appears as
yet another

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group associated to a geometric object and turns out to be a symmetry group using covering spaces and deck transformations. In the other direction, Cayley graphs, planar models, and fundamental domains appear

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as geometric
objects
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associated to
groups. The
final chapter
discusses groups
themselves as
geometric
objects,
including a
gentle
introduction to
Gromov's theorem
on polynomial

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*growth and
Grigorchuk's*

example of

intermediate

growth. The book

is accessible to

undergraduate

students (and

anyone else)

with a

background in

calculus, linear

algebra, and

basic real

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analysis,
including
topological
notions of
convergence and
connectedness.
This book is a
result of the
MASS course in
algebra at Penn
State University
in the fall
semester of
2009.