

COMPUTING FOR BIOLOGISTS PYTHON PROGRAMMING AND PRINCIPLES

COMPUTING FOR BIOLOGISTS PYTHON PROGRAMMING AND PRINCIPLES COMPUTING FOR BIOLOGISTS PYTHON PROGRAMMING AND PRINCIPLES THIS BLOG POST EXPLORES THE CRUCIAL ROLE OF COMPUTATIONAL SKILLS SPECIFICALLY PYTHON PROGRAMMING IN MODERN BIOLOGY IT DELVES INTO THE FUNDAMENTAL PRINCIPLES OF PROGRAMMING HIGHLIGHTING HOW PYTHON'S VERSATILITY EMPOWERS BIOLOGISTS TO TACKLE COMPLEX CHALLENGES ANALYZE VAST DATASETS AND CONTRIBUTE TO GROUNDBREAKING DISCOVERIES PYTHON BIOLOGY PROGRAMMING BIOINFORMATICS DATA ANALYSIS MACHINE LEARNING ETHICAL CONSIDERATIONS BIOLOGY IS RAPIDLY EVOLVING DRIVEN BY ADVANCEMENTS IN DATA ACQUISITION ANALYSIS AND INTERPRETATION PYTHON A USERFRIENDLY AND POWERFUL PROGRAMMING LANGUAGE HAS BECOME INDISPENSABLE FOR BIOLOGISTS NAVIGATING THIS DATA-DRIVEN LANDSCAPE THIS POST EXPLORES THE FUNDAMENTAL PRINCIPLES OF PROGRAMMING WITHIN THE CONTEXT OF BIOLOGICAL APPLICATIONS DELVING INTO KEY CONCEPTS LIKE DATA STRUCTURES ALGORITHMS AND COMPUTATIONAL MODELS IT EXAMINES HOW PYTHON FACILITATES ESSENTIAL TASKS LIKE SEQUENCE ANALYSIS GENE EXPRESSION ANALYSIS AND PROTEIN STRUCTURE PREDICTION FURTHERMORE IT DELVES INTO THE POTENTIAL OF MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE IN BIOLOGY WHILE ACKNOWLEDGING THE ETHICAL IMPLICATIONS OF THESE POWERFUL TOOLS ANALYSIS OF CURRENT TRENDS THE ADVENT OF HIGH-THROUGHPUT SEQUENCING TECHNOLOGIES COUPLED WITH ADVANCEMENTS IN IMAGING AND MICROSCOPY HAS GENERATED AN UNPRECEDENTED VOLUME OF BIOLOGICAL DATA THIS DELUGE OF INFORMATION NECESSITATES SOPHISTICATED COMPUTATIONAL TOOLS TO EXTRACT MEANINGFUL INSIGHTS PYTHON WITH ITS EXTENSIVE LIBRARIES AND ROBUST ECOSYSTEM HAS EMERGED AS A LEADING CHOICE FOR ANALYZING BIOLOGICAL DATA HERES A BREAKDOWN OF THE KEY TRENDS DRIVING THE ADOPTION OF PYTHON IN BIOLOGY

BIOINFORMATICS PYTHON IS AT THE HEART OF BIOINFORMATICS A DISCIPLINE THAT LEVERAGES COMPUTATIONAL METHODS TO ANALYZE AND INTERPRET BIOLOGICAL DATA LIBRARIES LIKE BIOPYTHON PROVIDE TOOLS FOR SEQUENCE ALIGNMENT GENE ANNOTATION AND PHYLOGENETIC ANALYSIS FACILITATING 2 CRUCIAL RESEARCH IN GENOMICS TRANSCRIPTOMICS AND PROTEOMICS

DATA ANALYSIS PYTHON OFFERS A WIDE RANGE OF LIBRARIES DEDICATED TO DATA ANALYSIS INCLUDING NUMPY PANDAS AND SCIPY THESE LIBRARIES ENABLE BIOLOGISTS TO MANIPULATE CLEAN AND VISUALIZE MASSIVE DATASETS IDENTIFYING PATTERNS AND TRENDS THAT MIGHT OTHERWISE BE HIDDEN

MACHINE LEARNING THE BURGEONING FIELD OF MACHINE LEARNING PARTICULARLY DEEP LEARNING IS REVOLUTIONIZING BIOLOGICAL RESEARCH PYTHON THROUGH LIBRARIES LIKE TENSORFLOW AND PYTORCH EMPOWERS BIOLOGISTS TO BUILD PREDICTIVE MODELS ANALYZE COMPLEX INTERACTIONS AND DEVELOP NOVEL DRUG THERAPIES

COMPUTATIONAL MODELING PYTHON'S VERSATILITY EXTENDS TO BUILDING COMPLEX COMPUTATIONAL MODELS THAT SIMULATE BIOLOGICAL PROCESSES THESE MODELS OFTEN RELYING ON TECHNIQUES LIKE AGENT-BASED MODELING OR NETWORK ANALYSIS OFFER INSIGHTS INTO BIOLOGICAL SYSTEMS THAT ARE DIFFICULT TO STUDY EXPERIMENTALLY

DISCUSSION OF ETHICAL CONSIDERATIONS WHILE PYTHON EMPOWERS BIOLOGISTS TO MAKE SIGNIFICANT CONTRIBUTIONS ITS ESSENTIAL TO ADDRESS THE ETHICAL CONSIDERATIONS THAT ARISE FROM THE USE OF POWERFUL COMPUTATIONAL TOOLS THESE INCLUDE

- DATA PRIVACY AND SECURITY** BIOLOGICAL DATA OFTEN CONTAINS SENSITIVE PERSONAL INFORMATION RESEARCHERS MUST PRIORITIZE DATA PRIVACY AND SECURITY ENSURING THAT DATA IS COLLECTED STORED AND ANALYZED RESPONSIBLY
- DATA BIAS AND FAIRNESS** THE ALGORITHMS AND MODELS USED IN BIOLOGICAL RESEARCH CAN INHERIT BIASES PRESENT IN THE TRAINING DATA BIOLOGISTS MUST BE MINDFUL OF POTENTIAL BIASES AND STRIVE TO DEVELOP ALGORITHMS THAT ARE FAIR AND EQUITABLE
- TRANSPARENCY AND REPRODUCIBILITY** THE SCIENTIFIC COMMUNITY RELIES ON TRANSPARENCY AND REPRODUCIBILITY BIOLOGISTS USING PYTHON SHOULD ADHERE TO BEST PRACTICES FOR CODE SHARING DOCUMENTATION AND DATA AVAILABILITY FOSTERING TRUST AND PROMOTING SCIENTIFIC RIGOR
- ACCESSIBILITY AND INCLUSIVITY** COMPUTATIONAL SKILLS INCLUDING PYTHON PROGRAMMING ARE INCREASINGLY ESSENTIAL FOR SUCCESS IN BIOLOGY ITS VITAL TO ENSURE THAT THESE SKILLS ARE ACCESSIBLE TO ALL RESEARCHERS REGARDLESS OF THEIR BACKGROUND OR EXPERIENCE LEVEL

LEARNING PYTHON FOR BIOLOGISTS THE GOOD NEWS IS THAT LEARNING PYTHON IS RELATIVELY ACCESSIBLE THANKS TO A WEALTH OF ONLINE RESOURCES AND LEARNING PLATFORMS

- ONLINE COURSES** PLATFORMS LIKE COURSERA EDX AND UDACITY OFFER COMPREHENSIVE PYTHON PROGRAMMING COURSES SPECIFICALLY TAILORED FOR BIOLOGISTS
- BOOKS** NUMEROUS EXCELLENT BOOKS INTRODUCE PYTHON PROGRAMMING CONCEPTS FOR BEGINNERS 3 WITH A FOCUS ON BIOLOGICAL APPLICATIONS
- ONLINE COMMUNITIES** JOINING ONLINE FORUMS

AND COMMUNITIES DEDICATED TO PYTHON AND BIOINFORMATICS PROVIDES VALUABLE SUPPORT RESOURCES AND OPPORTUNITIES FOR COLLABORATION CONCLUSION COMPUTATIONAL SKILLS PARTICULARLY PYTHON PROGRAMMING ARE NO LONGER OPTIONAL FOR BIOLOGISTS BY MASTERING PYTHON BIOLOGISTS CAN UNLOCK THE POWER OF DATA ANALYSIS LEVERAGE MACHINE LEARNING TO ACCELERATE RESEARCH AND CONTRIBUTE TO GROUNDBREAKING DISCOVERIES HOWEVER ITS ESSENTIAL TO NAVIGATE THIS POWERFUL TECHNOLOGY RESPONSIBLY ADDRESSING ETHICAL CONSIDERATIONS AND ENSURING THAT THE BENEFITS OF COMPUTATION ARE REALIZED FOR THE BETTERMENT OF SCIENCE AND SOCIETY

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ALLEGRA VIA
SEBASTIAN BASSI
AMARA HAWTHORN
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COMPUTING IS REVOLUTIONIZING THE PRACTICE OF BIOLOGY THIS BOOK WHICH ASSUMES NO PRIOR COMPUTING EXPERIENCE PROVIDES STUDENTS WITH THE TOOLS TO WRITE THEIR OWN PYTHON PROGRAMS AND TO UNDERSTAND FUNDAMENTAL CONCEPTS IN COMPUTATIONAL BIOLOGY AND BIOINFORMATICS EACH MAJOR PART OF THE BOOK BEGINS WITH A COMPELLING BIOLOGICAL QUESTION FOLLOWED BY THE ALGORITHMIC IDEAS AND PROGRAMMING TOOLS NECESSARY TO EXPLORE IT THE ORIGINS OF PATHOGENICITY ARE EXAMINED USING GENE FINDING THE EVOLUTIONARY HISTORY OF SEX DETERMINATION SYSTEMS IS STUDIED USING SEQUENCE ALIGNMENT AND THE ORIGIN OF MODERN HUMANS IS ADDRESSED USING PHYLOGENETIC METHODS IN ADDITION TO PROVIDING GENERAL PROGRAMMING SKILLS THIS BOOK EXPLORES THE DESIGN OF EFFICIENT ALGORITHMS SIMULATION NP HARDNESS AND THE MAXIMUM LIKELIHOOD METHOD AMONG OTHER KEY CONCEPTS AND METHODS EASY TO READ AND DESIGNED TO EQUIP STUDENTS WITH THE SKILLS TO WRITE PROGRAMS FOR SOLVING A RANGE OF BIOLOGICAL PROBLEMS THE BOOK IS ACCOMPANIED BY NUMEROUS PROGRAMMING EXERCISES AVAILABLE AT CS HMC EDU CFB

THIS BOOK TEACHES LIFE SCIENCE STUDENTS HOW TO USE PYTHON PROGRAMMING AND COMPUTATIONAL PROBLEM SOLVING IN THE CONTEXT OF COMPELLING BIOLOGICAL APPLICATIONS

TREAT YOURSELF TO A LIVELY INTUITIVE AND EASY TO FOLLOW INTRODUCTION TO COMPUTER PROGRAMMING IN PYTHON THE BOOK WAS WRITTEN SPECIFICALLY FOR BIOLOGISTS WITH LITTLE OR NO PRIOR EXPERIENCE OF WRITING CODE WITH THE GOAL OF GIVING THEM NOT ONLY A FOUNDATION IN PYTHON PROGRAMMING BUT ALSO THE CONFIDENCE AND INSPIRATION TO START USING PYTHON IN THEIR OWN RESEARCH VIRTUALLY ALL OF THE EXAMPLES IN THE BOOK ARE DRAWN FROM ACROSS A WIDE SPECTRUM OF LIFE SCIENCE RESEARCH FROM SIMPLE BIOCHEMICAL CALCULATIONS AND SEQUENCE ANALYSIS TO

MODELING THE DYNAMIC INTERACTIONS OF GENES AND PROTEINS IN CELLS OR THE DRIFT OF GENES IN AN EVOLVING POPULATION BEST OF ALL PYTHON FOR THE LIFE SCIENCES SHOWS YOU HOW TO IMPLEMENT ALL OF THESE PROJECTS IN PYTHON ONE OF THE MOST POPULAR PROGRAMMING LANGUAGES FOR SCIENTIFIC COMPUTING IF YOU ARE A LIFE SCIENTIST INTERESTED IN LEARNING PYTHON TO JUMP START YOUR RESEARCH THIS IS THE BOOK FOR YOU WHAT YOU LL LEARN WRITE PYTHON SCRIPTS TO AUTOMATE YOUR LAB CALCULATIONS SEARCH FOR IMPORTANT MOTIFS IN GENOME SEQUENCES USE OBJECT ORIENTED PROGRAMMING WITH PYTHON STUDY MINING INTERACTION NETWORK DATA FOR PATTERNS REVIEW DYNAMIC MODELING OF BIOCHEMICAL SWITCHES WHO THIS BOOK IS FOR LIFE SCIENTISTS WITH LITTLE OR NO PROGRAMMING EXPERIENCE INCLUDING UNDERGRADUATE AND GRADUATE STUDENTS POSTDOCTORAL RESEARCHERS IN ACADEMIA AND INDUSTRY MEDICAL PROFESSIONALS AND TEACHERS LECTURERS A COMPREHENSIVE INTRODUCTION TO USING PYTHON FOR COMPUTATIONAL BIOLOGY A LOVELY BOOK WITH HUMOR AND PERSPECTIVE JOHN NOVEMBRE ASSOCIATE PROFESSOR OF HUMAN GENETICS UNIVERSITY OF CHICAGO AND MACARTHUR FELLOW FUN ENTERTAINING WITTY AND DARN USEFUL AMAGICAL PORTAL TO THE BIG DATA REVOLUTION SANDRO SANTAGATA ASSISTANT PROFESSOR IN PATHOLOGY HARVARD MEDICAL SCHOOL ALEX AND GORDON S ENTHUSIASM FOR PYTHON IS CONTAGIOUS GLENYS THOMSON PROFESSOR OF INTEGRATIVE BIOLOGY UNIVERSITY OF CALIFORNIA BERKELEY

PYTHON FOR BIOLOGISTS IS A COMPLETE PROGRAMMING COURSE FOR BEGINNERS THAT WILL GIVE YOU THE SKILLS YOU NEED TO TACKLE COMMON BIOLOGICAL AND BIOINFORMATICS PROBLEMS

HANDS ON DATA SCIENCE FOR BIOLOGISTS USING PYTHON HAS BEEN CONCEPTUALIZED TO ADDRESS THE MASSIVE DATA HANDLING NEEDS OF MODERN DAY BIOLOGISTS WITH THE ADVENT OF HIGH THROUGHPUT TECHNOLOGIES AND CONSEQUENT AVAILABILITY OF OMICS DATA BIOLOGICAL SCIENCE HAS BECOME A DATA INTENSIVE FIELD THIS HANDS ON TEXTBOOK HAS BEEN WRITTEN WITH THE INCEPTION OF EASING DATA ANALYSIS BY PROVIDING AN INTERACTIVE PROBLEM BASED INSTRUCTIONAL APPROACH IN PYTHON PROGRAMMING LANGUAGE THE BOOK STARTS WITH AN INTRODUCTION TO PYTHON AND STEADILY DELVES INTO SCRUPULOUS TECHNIQUES OF DATA HANDLING PREPROCESSING AND VISUALIZATION THE BOOK CONCLUDES WITH MACHINE LEARNING ALGORITHMS AND THEIR APPLICATIONS IN BIOLOGICAL DATA SCIENCE EACH TOPIC HAS AN INTUITIVE EXPLANATION OF CONCEPTS AND IS ACCOMPANIED WITH BIOLOGICAL EXAMPLES FEATURES OF THIS BOOK THE BOOK CONTAINS STANDARD TEMPLATES FOR DATA ANALYSIS USING PYTHON SUITABLE FOR BEGINNERS AS WELL AS ADVANCED LEARNERS THIS BOOK SHOWS WORKING IMPLEMENTATIONS OF DATA HANDLING AND MACHINE LEARNING ALGORITHMS USING REAL LIFE BIOLOGICAL DATASETS AND PROBLEMS SUCH AS GENE EXPRESSION ANALYSIS DISEASE PREDICTION IMAGE RECOGNITION SNP ASSOCIATION WITH PHENOTYPES AND DISEASES CONSIDERING THE IMPORTANCE OF VISUALIZATION FOR DATA INTERPRETATION ESPECIALLY IN BIOLOGICAL SYSTEMS THERE IS A DEDICATED CHAPTER FOR THE EASE OF DATA VISUALIZATION AND PLOTTING EVERY CHAPTER IS DESIGNED TO BE INTERACTIVE AND IS ACCOMPANIED WITH JUPYTER NOTEBOOK TO PROMPT READERS TO PRACTICE IN THEIR LOCAL SYSTEMS OTHER AVANT GARDE COMPONENT OF THE BOOK IS THE INCLUSION OF A MACHINE LEARNING PROJECT WHEREIN VARIOUS MACHINE LEARNING ALGORITHMS ARE APPLIED FOR THE IDENTIFICATION OF GENES ASSOCIATED WITH AGE RELATED DISORDERS A SYSTEMATIC UNDERSTANDING OF DATA ANALYSIS STEPS HAS ALWAYS BEEN AN IMPORTANT ELEMENT FOR BIOLOGICAL RESEARCH THIS BOOK IS A READILY ACCESSIBLE RESOURCE THAT CAN BE USED AS A HANDBOOK FOR DATA ANALYSIS AS WELL AS A PLATTER OF STANDARD CODE TEMPLATES FOR BUILDING MODELS

PYTHON IS RAPIDLY BECOMING THE STANDARD LANGUAGE FOR MANY TALKS IN SCIENTIFIC RESEARCH AND IS PARTICULARLY POPULAR IN BIOLOGY AND BIOINFORMATICS ONE OF THE GREAT STRENGTHS OF PYTHON IS THE ECOSYSTEM OF TOOLS AND LIBRARIES THAT HAVE GROWN UP AROUND IT THIS BOOK INTRODUCES THE NOVICE BIOLOGIST PROGRAMMER TO TOOLS AND TECHNIQUES THAT MAKE DEVELOPING PYTHON CODE EASIER AND FASTER AND WILL HELP YOU TO WRITE MORE RELIABLE PERFORMANT PROGRAMS WRITTEN BY A BIOLOGIST IT FOCUSSES ON SOLVING THE PROBLEMS THAT STUDENTS AND RESEARCHERS ENCOUNTER EVERY DAY HOW DO I MAKE MY PROGRAM RUN FASTER HOW CAN I BE SURE THAT MY RESULTS ARE CORRECT HOW DO I SHARE THIS PROGRAM WITH MY COLLEAGUES HOW CAN I SPEED UP THE PROCESS OF WRITING MY CODE CHAPTERS INCLUDE ENVIRONMENTS FOR DEVELOPMENT LEARN HOW YOU CAN TAKE ADVANTAGE OF DIFFERENT TOOLS FOR ACTUALLY WRITING CODE INCLUDING THOSE DESIGNED SPECIFICALLY FOR SCIENTIFIC WORK ORGANISING AND SHARING CODE LEARN HOW PYTHON S MODULE AND PACKAGING SYSTEM WORKS HOW TO EFFECTIVELY REUSE CODE ACROSS MULTIPLE PROJECTS AND HOW TO SHARE YOUR PROGRAMS WITH COLLEAGUES AND THE WIDER WORLD TESTING LEARN HOW AUTOMATED TESTING CAN MAKE YOUR CODE MORE RELIABLE HOW TO CATCH BUGS BEFORE THEY IMPACT YOUR WORK AND HOW TO EDIT CODE WITH CONFIDENCE PERFORMANCE LEARN HOW TO MAKE YOUR CODE RUN QUICKLY EVEN ON LARGE DATASETS HOW TO UNDERSTAND THE SCALING BEHAVIOUR OF YOUR

CODE AND EXPLORE THE TRADE OFFS INVOLVED IN DESIGNING CODE USER INTERFACES LEARN HOW TO MAKE YOUR CODE MORE USER FRIENDLY HOW TO DESIGN EFFECTIVE INTERFACES AND HOW TO AUTOMATE RECORD KEEPING WITH PYTHON S LOGGING SYSTEM ABOUT THE AUTHOR MARTIN STARTED HIS PROGRAMMING CAREER BY LEARNING PERL DURING THE COURSE OF HIS PHD IN EVOLUTIONARY BIOLOGY AND STARTED TEACHING OTHER PEOPLE TO PROGRAM SOON AFTER SINCE THEN HE HAS TAUGHT INTRODUCTORY PROGRAMMING TO HUNDREDS OF BIOLOGISTS FROM UNDERGRADUATES TO PIS AND HAS MAINTAINED A PHILOSOPHY THAT PROGRAMMING COURSES MUST BE FRIENDLY APPROACHABLE AND PRACTICAL IN HIS ACADEMIC CAREER MARTIN MIXED RESEARCH AND TEACHING AT THE UNIVERSITY OF EDINBURGH CULMINATING IN A TWO YEAR STINT AS LECTURER IN BIOINFORMATICS HE NOW RUNS PROGRAMMING COURSES FOR BIOLOGICAL RESEARCHERS AS A FULL TIME FREELANCER PRAISE FOR MARTIN S PREVIOUS BOOKS GREAT GREAT BOOK I THINK THIS IS THE PERFECT BOOK FOR ANY BIOLOGIST TO WHO WANTS TO START LEARNING TO CODE WITH PYTHON I DIDN T KNOW A COMMAND LINE FROM A HOLE IN THE GROUND WHEN I FIRST OPENED UP THIS BOOK AND MERE DAYS LATER I WAS IMPRESSING MY COLLEAGUES WITH MY OWN DNA ANALYSIS PROGRAMS ZERO TO WRITING USEFUL PROGRAMS IN A WEEKEND PYTHON FOR BIOLOGISTS ARRIVED LAST THURSDAY 6 16 16 I SPENT THE WHOLE WEEKEND GLUED TO MY LAPTOP IN A 2 1 2 DAY FRENZY OF CODING AND I JUST FINISHED IT AND CAME ON AMAZON TO ORDER THE NEXT ONE ONE OF THE BEST CODING BOOKS I VE USED IN A LONG TIME DIRECT APPLICATIONS IN BIOINFORMATICS I BOUGHT THE ADVANCED PYTHON BOOK TOO THE MOST USEFUL GUIDE TO PYTHON I VE FOUND I VE TRIED A FEW PYTHON BOOKS AND THIS IS BY FAR THE BEST FOR ME

ADVANCED PYTHON FOR BIOLOGISTS IS A PROGRAMMING COURSE FOR WORKERS IN BIOLOGY AND BIOINFORMATICS WHO WANT TO DEVELOP THEIR PROGRAMMING SKILLS IT STARTS WITH THE BASIC PYTHON KNOWLEDGE OUTLINED IN PYTHON FOR BIOLOGISTS AND INTRODUCES ADVANCED PYTHON TOOLS AND TECHNIQUES WITH BIOLOGICAL EXAMPLES YOU LL LEARN HOW TO USE OBJECT ORIENTED PROGRAMMING TO MODEL BIOLOGICAL ENTITIES HOW TO WRITE MORE ROBUST CODE AND PROGRAMS BY USING PYTHON S EXCEPTION SYSTEM HOW TO TEST YOUR CODE USING THE UNIT TESTING FRAMEWORK HOW TO TRANSFORM DATA USING PYTHON S COMPREHENSIONS HOW TO WRITE FLEXIBLE FUNCTIONS AND APPLICATIONS USING FUNCTIONAL PROGRAMMING HOW TO USE PYTHON S ITERATION FRAMEWORK TO EXTEND YOUR OWN OBJECT AND FUNCTIONS ADVANCED PYTHON FOR BIOLOGISTS IS WRITTEN WITH AN EMPHASIS ON PRACTICAL PROBLEM SOLVING AND USES EVERYDAY BIOLOGICAL EXAMPLES THROUGHOUT EACH SECTION CONTAINS EXERCISES ALONG WITH SOLUTIONS AND DETAILED DISCUSSION

THIS BOOK INTRODUCES PYTHON AS A POWERFUL TOOL FOR THE INVESTIGATION OF PROBLEMS IN COMPUTATIONAL BIOLOGY FOR NOVICES AND EXPERIENCED PROGRAMMERS ALIKE

TAKE CONTROL OF YOUR DATA AND USE PYTHON WITH CONFIDENCE REQUIRING NO PRIOR PROGRAMMING EXPERIENCE MANAGING YOUR BIOLOGICAL DATA WITH PYTHON EMPOWERS BIOLOGISTS AND OTHER LIFE SCIENTISTS TO WORK WITH BIOLOGICAL DATA ON THEIR OWN USING THE PYTHON LANGUAGE THE BOOK TEACHES THEM NOT ONLY HOW TO PROGRAM BUT ALSO HOW TO MANAGE THEIR DATA IT SHOWS HOW

IN TODAY S DATA DRIVEN BIOLOGY PROGRAMMING KNOWLEDGE IS ESSENTIAL IN TURNING IDEAS INTO TESTABLE HYPOTHESIS BASED ON THE AUTHOR S EXTENSIVE EXPERIENCE PYTHON FOR BIOINFORMATICS SECOND EDITION HELPS BIOLOGISTS GET TO GRIPS WITH THE BASICS OF SOFTWARE DEVELOPMENT REQUIRING NO PRIOR KNOWLEDGE OF PROGRAMMING RELATED CONCEPTS THE BOOK FOCUSES ON THE EASY TO USE YET POWERFUL PYTHON COMPUTER LANGUAGE THIS NEW EDITION IS UPDATED THROUGHOUT TO PYTHON 3 AND IS DESIGNED NOT JUST TO HELP SCIENTISTS MASTER THE BASICS BUT TO DO MORE IN LESS TIME AND IN A REPRODUCIBLE WAY NEW DEVELOPMENTS ADDED IN THIS EDITION INCLUDE NOSQL DATABASES THE ANACONDA PYTHON DISTRIBUTION GRAPHICAL LIBRARIES LIKE BOKEH AND THE USE OF GITHUB FOR COLLABORATIVE DEVELOPMENT

IN CODING FOR BIOLOGISTS AN INTRODUCTION TO BIOINFORMATICS YOU LL LEARN HOW TO HARNESS THE POWER OF PYTHON TO HANDLE REAL BIOLOGICAL DATASETS FROM GENE SEQUENCES TO PROTEIN STRUCTURES NO PRIOR CODING KNOWLEDGE IS REQUIRED EVERYTHING IS EXPLAINED STEP BY STEP WITH CLEAR EXAMPLES DRAWN DIRECTLY FROM THE LIFE SCIENCES WHAT YOU LL LEARN INSIDE THE BASICS OF PYTHON PROGRAMMING TAILORED FOR BIOLOGICAL DATA HOW TO PROCESS DNA RNA AND PROTEIN SEQUENCES WITH PRACTICAL SCRIPTS DATA ANALYSIS TECHNIQUES TO UNCOVER PATTERNS IN GENOMES

AND EXPERIMENTS HOW BIOINFORMATICS TOOLS ACCELERATE DISCOVERIES IN GENETICS AND MOLECULAR BIOLOGY HANDS ON PROJECTS THAT CONNECT THEORY WITH REAL WORLD BIOLOGY APPLICATIONS

THIS FIRST INTRODUCTORY BOOK DESIGNED TO TRAIN NOVICE PROGRAMMERS IS BASED ON A STUDENT COURSE TAUGHT BY THE AUTHOR AND HAS BEEN OPTIMIZED FOR BIOLOGY STUDENTS WITHOUT PREVIOUS EXPERIENCE IN PROGRAMMING BY INTERSPERSING THEORY CHAPTERS WITH NUMEROUS SMALL AND LARGE PROGRAMMING EXERCISES THE AUTHOR QUICKLY SHOWS READERS HOW TO DO THEIR OWN PROGRAMMING AND THROUGHOUT USES ANECDOTES AND REAL LIFE EXAMPLES FROM THE BIOSCIENCES TO SPICE UP THE TEXT THIS PRACTICAL BOOK THUS TEACHES ESSENTIAL PROGRAMMING SKILLS FOR LIFE SCIENTISTS WHO WANT OR NEED TO WRITE THEIR OWN BIOINFORMATICS SOFTWARE TOOLS

DO YOU HAVE A BIOLOGICAL QUESTION THAT COULD BE READILY ANSWERED BY COMPUTATIONAL TECHNIQUES BUT LITTLE EXPERIENCE IN PROGRAMMING DO YOU WANT TO LEARN MORE ABOUT THE CORE TECHNIQUES USED IN COMPUTATIONAL BIOLOGY AND BIOINFORMATICS WRITTEN IN AN ACCESSIBLE STYLE THIS GUIDE PROVIDES A FOUNDATION FOR BOTH NEWCOMERS TO COMPUTER PROGRAMMING AND THOSE INTERESTED IN LEARNING MORE ABOUT COMPUTATIONAL BIOLOGY THE CHAPTERS GUIDE THE READER THROUGH A COMPLETE BEGINNERS COURSE TO PROGRAMMING IN PYTHON WITH AN INTRODUCTION TO COMPUTING JARGON DESCRIPTIONS OF CORE BIOINFORMATICS METHODS WITH WORKING PYTHON EXAMPLES SCIENTIFIC COMPUTING TECHNIQUES INCLUDING IMAGE ANALYSIS STATISTICS AND MACHINE LEARNING THIS BOOK ALSO FUNCTIONS AS A LANGUAGE REFERENCE WRITTEN IN STRAIGHTFORWARD ENGLISH COVERING THE MOST COMMON PYTHON LANGUAGE ELEMENTS AND A GLOSSARY OF COMPUTING AND BIOLOGICAL TERMS THIS TITLE WILL TEACH UNDERGRADUATES POSTGRADUATES AND PROFESSIONALS WORKING IN THE LIFE SCIENCES HOW TO PROGRAM WITH PYTHON A POWERFUL FLEXIBLE AND EASY TO USE LANGUAGE

IF BIOLOGY IN THE 20TH CENTURY WAS CHARACTERIZED BY AN EXPLOSION OF NEW TECHNOLOGIES AND EXPERIMENTAL METHODS THAT OF THE 21ST HAS SEEN AN EQUALLY EXUBERANT PROLIFERATION OF MATHEMATICAL AND COMPUTATIONAL METHODS THAT ATTEMPT TO SYSTEMATIZE AND EXPLAIN THE ABUNDANCE OF AVAILABLE DATA AS WE LIVE THROUGH THE CONSOLIDATION OF A NEW PARADIGM WHERE EXPERIMENTAL DATA GOES HAND IN HAND WITH COMPUTATIONAL ANALYSIS WE CONTEMPLATE THE CHALLENGE OF FUSING THESE TWO ASPECTS OF THE NEW BIOLOGY INTO A CONSISTENT THEORETICAL FRAMEWORK WHETHER SYSTEMS BIOLOGY WILL SURVIVE AS A FIELD OR BE WASHED AWAY BY THE TIDES OF FUTURE FADS WILL ULTIMATELY DEPEND ON ITS SUCCESS TO ACHIEVE THIS TYPE OF SYNTHESIS THE FAMOUS QUOTE ATTRIBUTED TO KURT LEWIN COMES TO MIND THERE IS NOTHING MORE PRACTICAL THAN A GOOD THEORY THIS BOOK PRESENTS A WIDE ASSORTMENT OF ARTICLES ON SYSTEMS BIOLOGY IN AN ATTEMPT TO CAPTURE THE VARIETY OF CURRENT METHODS IN SYSTEMS BIOLOGY AND SHOW HOW THEY CAN HELP TO FIND ANSWERS TO THE CHALLENGES OF MODERN BIOLOGY

DISCOVER MODERN NEXT GENERATION SEQUENCING LIBRARIES FROM PYTHON ECOSYSTEM TO ANALYZE LARGE AMOUNTS OF BIOLOGICAL DATA KEY FEATURES PERFORM COMPLEX BIOINFORMATICS ANALYSIS USING THE MOST IMPORTANT PYTHON LIBRARIES AND APPLICATIONS IMPLEMENT NEXT GENERATION SEQUENCING METAGENOMICS AUTOMATING ANALYSIS POPULATION GENETICS AND MORE EXPLORE VARIOUS STATISTICAL AND MACHINE LEARNING TECHNIQUES FOR BIOINFORMATICS DATA ANALYSIS BOOK DESCRIPTION BIOINFORMATICS IS AN ACTIVE RESEARCH FIELD THAT USES A RANGE OF SIMPLE TO ADVANCED COMPUTATIONS TO EXTRACT VALUABLE INFORMATION FROM BIOLOGICAL DATA THIS BOOK COVERS NEXT GENERATION SEQUENCING GENOMICS METAGENOMICS POPULATION GENETICS PHYLOGENETICS AND PROTEOMICS YOU LL LEARN MODERN PROGRAMMING TECHNIQUES TO ANALYZE LARGE AMOUNTS OF BIOLOGICAL DATA WITH THE HELP OF REAL WORLD EXAMPLES YOU LL CONVERT ANALYZE AND VISUALIZE DATASETS USING VARIOUS PYTHON TOOLS AND LIBRARIES THIS BOOK WILL HELP YOU GET A BETTER UNDERSTANDING OF WORKING WITH A GALAXY SERVER WHICH IS THE MOST WIDELY USED BIOINFORMATICS WEB BASED PIPELINE SYSTEM THIS UPDATED EDITION ALSO INCLUDES ADVANCED NEXT GENERATION SEQUENCING FILTERING TECHNIQUES YOU LL ALSO EXPLORE TOPICS SUCH AS SNP DISCOVERY USING STATISTICAL APPROACHES UNDER HIGH PERFORMANCE COMPUTING FRAMEWORKS SUCH AS DASK AND SPARK BY THE END OF THIS BOOK YOU LL BE ABLE TO USE AND IMPLEMENT MODERN PROGRAMMING TECHNIQUES AND FRAMEWORKS TO DEAL WITH THE EVER INCREASING DELUGE OF BIOINFORMATICS DATA WHAT YOU WILL LEARN LEARN HOW TO PROCESS LARGE NEXT GENERATION SEQUENCING NGS DATASETS WORK WITH GENOMIC DATASET USING THE FASTQ BAM AND VCF FORMATS LEARN TO PERFORM SEQUENCE COMPARISON AND PHYLOGENETIC RECONSTRUCTION PERFORM COMPLEX ANALYSIS WITH PROTEMICS

DATA USE PYTHON TO INTERACT WITH GALAXY SERVERS USE HIGH PERFORMANCE COMPUTING TECHNIQUES WITH DASK AND SPARK VISUALIZE PROTEIN DATASET INTERACTIONS USING CYTOSCAPE USE PCA AND DECISION TREES TWO MACHINE LEARNING TECHNIQUES WITH BIOLOGICAL DATASETS WHO THIS BOOK IS FOR THIS BOOK IS FOR DATA DATA SCIENTISTSSCIENTISTS BIOINFORMATICS BIOINFORMATICS ANALYSTS RESEARCHERS AND PYTHON DEVELOPERS WHO WANT TO ADDRESS INTERMEDIATE TO ADVANCED BIOLOGICAL AND BIOINFORMATICS PROBLEMS USING A RECIPE BASED APPROACH WORKING KNOWLEDGE OF THE PYTHON PROGRAMMING LANGUAGE IS EXPECTED

INTEGER LINEAR PROGRAMMING ILP IS A VERSATILE MODELING AND OPTIMIZATION TECHNIQUE THAT IS INCREASINGLY USED IN NON TRADITIONAL WAYS IN BIOLOGY WITH THE POTENTIAL TO TRANSFORM BIOLOGICAL COMPUTATION HOWEVER FEW BIOLOGISTS KNOW ABOUT IT THIS HOW TO AND WHY DO TEXT INTRODUCES ILP THROUGH THE LENS OF COMPUTATIONAL AND SYSTEMS BIOLOGY IT USES IN DEPTH EXAMPLES FROM GENOMICS PHYLOGENETICS RNA PROTEIN FOLDING NETWORK ANALYSIS CANCER ECOLOGY CO EVOLUTION DNA SEQUENCING SEQUENCE ANALYSIS PEDIGREE AND SIBLING INFERENCE HAPLOTYPING AND MORE TO ESTABLISH THE POWER OF ILP THIS BOOK AIMS TO TEACH THE LOGIC OF MODELING AND SOLVING PROBLEMS WITH ILP AND TO TEACH THE PRACTICAL WORK FLOW INVOLVED IN USING ILP IN BIOLOGY WRITTEN FOR A WIDE AUDIENCE WITH NO BIOLOGICAL OR COMPUTATIONAL PREREQUISITES THIS BOOK IS APPROPRIATE FOR ENTRY LEVEL AND ADVANCED COURSES AIMED AT BIOLOGICAL AND COMPUTATIONAL STUDENTS AND AS A SOURCE FOR SPECIALISTS NUMEROUS EXERCISES AND ACCOMPANYING SOFTWARE IN PYTHON AND PERL DEMONSTRATE THE CONCEPTS

BRINGING THIS BEST SELLING TEXTBOOK RIGHT UP TO DATE THE NEW EDITION UNIQUELY INTEGRATES THE THEORIES AND METHODS THAT DRIVE THE FIELDS OF BIOLOGY BIOTECHNOLOGY AND MEDICINE COMPREHENSIVELY COVERING BOTH THE TECHNIQUES STUDENTS WILL ENCOUNTER IN LAB CLASSES AND THOSE THAT UNDERPIN CURRENT KEY ADVANCES AND DISCOVERIES THE CONTENTS HAVE BEEN UPDATED TO INCLUDE BOTH TRADITIONAL AND CUTTING EDGE TECHNIQUES MOST COMMONLY USED IN CURRENT LIFE SCIENCE RESEARCH EMPHASIS IS PLACED ON UNDERSTANDING THE THEORY BEHIND THE TECHNIQUES AS WELL AS ANALYSIS OF THE RESULTING DATA NEW CHAPTERS COVER PROTEOMICS GENOMICS METABOLOMICS BIOINFORMATICS AS WELL AS DATA ANALYSIS AND VISUALISATION USING ACCESSIBLE LANGUAGE TO DESCRIBE CONCEPTS AND METHODS AND WITH A WEALTH OF NEW IN TEXT WORKED EXAMPLES TO CHALLENGE STUDENTS UNDERSTANDING THIS TEXTBOOK PROVIDES AN ESSENTIAL GUIDE TO THE KEY TECHNIQUES USED IN CURRENT BIOSCIENCE RESEARCH

A PRIMER FOR COMPUTATIONAL BIOLOGY AIMS TO PROVIDE LIFE SCIENTISTS AND STUDENTS THE SKILLS NECESSARY FOR RESEARCH IN A DATA RICH WORLD THE TEXT COVERS ACCESSING AND USING REMOTE SERVERS VIA THE COMMAND LINE WRITING PROGRAMS AND PIPELINES FOR DATA ANALYSIS AND PROVIDES USEFUL VOCABULARY FOR INTERDISCIPLINARY WORK THE BOOK IS BROKEN INTO THREE PARTS INTRODUCTION TO UNIX LINUX THE COMMAND LINE IS THE NATURAL ENVIRONMENT OF SCIENTIFIC COMPUTING AND THIS PART COVERS A WIDE RANGE OF TOPICS INCLUDING LOGGING IN WORKING WITH FILES AND DIRECTORIES INSTALLING PROGRAMS AND WRITING SCRIPTS AND THE POWERFUL PIPE OPERATOR FOR FILE AND DATA MANIPULATION PROGRAMMING IN PYTHON PYTHON IS BOTH A PREMIER LANGUAGE FOR LEARNING AND A COMMON CHOICE IN SCIENTIFIC SOFTWARE DEVELOPMENT THIS PART COVERS THE BASIC CONCEPTS IN PROGRAMMING DATA TYPES IF STATEMENTS AND LOOPS FUNCTIONS VIA EXAMPLES OF DNA SEQUENCE ANALYSIS THIS PART ALSO COVERS MORE COMPLEX SUBJECTS IN SOFTWARE DEVELOPMENT SUCH AS OBJECTS AND CLASSES MODULES AND APIS PROGRAMMING IN R THE R LANGUAGE SPECIALIZES IN STATISTICAL DATA ANALYSIS AND IS ALSO QUITE USEFUL FOR VISUALIZING LARGE DATASETS THIS THIRD PART COVERS THE BASICS OF R AS A PROGRAMMING LANGUAGE DATA TYPES IF STATEMENTS FUNCTIONS LOOPS AND WHEN TO USE THEM AS WELL AS TECHNIQUES FOR LARGE SCALE MULTI TEST ANALYSES OTHER TOPICS INCLUDE S3 CLASSES AND DATA VISUALIZATION WITH GGLOT2

LIFE SCIENTISTS TODAY URGENTLY NEED TRAINING IN BIOINFORMATICS SKILLS TOO MANY BIOINFORMATICS PROGRAMS ARE POORLY WRITTEN AND BARELY MAINTAINED USUALLY BY STUDENTS AND RESEARCHERS WHO VE NEVER LEARNED BASIC PROGRAMMING SKILLS THIS PRACTICAL GUIDE SHOWS POSTDOC BIOINFORMATICS PROFESSIONALS AND STUDENTS HOW TO EXPLOIT THE BEST PARTS OF PYTHON TO SOLVE PROBLEMS IN BIOLOGY WHILE CREATING DOCUMENTED TESTED REPRODUCIBLE SOFTWARE KEN YOUENS CLARK AUTHOR OF TINY PYTHON PROJECTS MANNING DEMONSTRATES NOT ONLY HOW TO WRITE EFFECTIVE PYTHON CODE BUT ALSO HOW TO USE TESTS TO WRITE AND REFACTOR SCIENTIFIC PROGRAMS YOU LL LEARN THE LATEST PYTHON FEATURES AND TOOLS INCLUDING LINTERS FORMATTERS TYPE CHECKERS AND

TESTS TO CREATE DOCUMENTED AND TESTED PROGRAMS YOU LL ALSO TACKLE 14 CHALLENGES IN ROSALIND A PROBLEM SOLVING PLATFORM FOR LEARNING BIOINFORMATICS AND PROGRAMMING CREATE COMMAND LINE PYTHON PROGRAMS TO DOCUMENT AND VALIDATE PARAMETERS WRITE TESTS TO VERIFY REFACTOR PROGRAMS AND CONFIRM THEY RE CORRECT ADDRESS BIOINFORMATICS IDEAS USING PYTHON DATA STRUCTURES AND MODULES SUCH AS BIOPYTHON CREATE REPRODUCIBLE SHORTCUTS AND WORKFLOWS USING MAKEFILES PARSE ESSENTIAL BIOINFORMATICS FILE FORMATS SUCH AS FASTA AND FASTQ FIND PATTERNS OF TEXT USING REGULAR EXPRESSIONS USE HIGHER ORDER FUNCTIONS IN PYTHON LIKE FILTER MAP AND REDUCE

A CONCISE INTRODUCTION TO KEY COMPUTING SKILLS FOR BIOLOGISTS WHILE BIOLOGICAL DATA CONTINUES TO GROW EXPONENTIALLY IN SIZE AND QUALITY MANY OF TODAY S BIOLOGISTS ARE NOT TRAINED ADEQUATELY IN THE COMPUTING SKILLS NECESSARY FOR LEVERAGING THIS INFORMATION DELUGE IN COMPUTING SKILLS FOR BIOLOGISTS STEFANO ALLESINA AND MADLEN WILMES PRESENT A VALUABLE TOOLBOX FOR THE EFFECTIVE ANALYSIS OF BIOLOGICAL DATA BASED ON THE AUTHORS EXPERIENCES TEACHING SCIENTIFIC COMPUTING AT THE UNIVERSITY OF CHICAGO THIS TEXTBOOK EMPHASIZES THE AUTOMATION OF REPETITIVE TASKS AND THE CONSTRUCTION OF PIPELINES FOR DATA ORGANIZATION ANALYSIS VISUALIZATION AND PUBLICATION STRESSING PRACTICE RATHER THAN THEORY THE BOOK S EXAMPLES AND EXERCISES ARE DRAWN FROM ACTUAL BIOLOGICAL DATA AND SOLVE COGENT PROBLEMS SPANNING THE ENTIRE BREADTH OF BIOLOGICAL DISCIPLINES INCLUDING ECOLOGY GENETICS MICROBIOLOGY AND MOLECULAR BIOLOGY BEGINNERS WILL BENEFIT FROM THE MANY EXAMPLES EXPLAINED STEP BY STEP WHILE MORE SEASONED RESEARCHERS WILL LEARN HOW TO COMBINE TOOLS TO MAKE BIOLOGICAL DATA ANALYSIS ROBUST AND REPRODUCIBLE THE BOOK USES FREE SOFTWARE AND CODE THAT CAN BE RUN ON ANY PLATFORM COMPUTING SKILLS FOR BIOLOGISTS IS IDEAL FOR SCIENTISTS WANTING TO IMPROVE THEIR TECHNICAL SKILLS AND INSTRUCTORS LOOKING TO TEACH THE MAIN COMPUTING TOOLS ESSENTIAL FOR BIOLOGY RESEARCH IN THE TWENTY FIRST CENTURY EXCELLENT RESOURCE FOR ACQUIRING COMPREHENSIVE COMPUTING SKILLS BOTH NOVICE AND EXPERIENCED SCIENTISTS WILL INCREASE EFFICIENCY BY BUILDING AUTOMATED AND REPRODUCIBLE PIPELINES FOR BIOLOGICAL DATA ANALYSIS CODE EXAMPLES BASED ON PUBLISHED DATA SPANNING THE BREADTH OF BIOLOGICAL DISCIPLINES DETAILED SOLUTIONS PROVIDED FOR EXERCISES IN EACH CHAPTER EXTENSIVE COMPANION WEBSITE

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4. HOW DO I TAKE CARE OF COMPUTING FOR BIOLOGISTS PYTHON PROGRAMMING AND PRINCIPLES BOOKS? STORAGE: KEEP THEM AWAY FROM DIRECT SUNLIGHT AND IN A DRY ENVIRONMENT. HANDLING: AVOID FOLDING PAGES, USE BOOKMARKS, AND HANDLE THEM WITH CLEAN HANDS. CLEANING: GENTLY DUST THE COVERS AND PAGES OCCASIONALLY.
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8. HOW DO I SUPPORT AUTHORS OR THE BOOK INDUSTRY? BUY BOOKS: PURCHASE BOOKS FROM AUTHORS OR INDEPENDENT BOOKSTORES. REVIEWS: LEAVE REVIEWS ON PLATFORMS LIKE GOODREADS OR AMAZON. PROMOTION: SHARE YOUR FAVORITE BOOKS ON SOCIAL MEDIA OR RECOMMEND THEM TO FRIENDS.
9. ARE THERE BOOK CLUBS OR READING COMMUNITIES I CAN JOIN? LOCAL CLUBS: CHECK FOR LOCAL BOOK CLUBS IN LIBRARIES OR COMMUNITY CENTERS. ONLINE COMMUNITIES: PLATFORMS LIKE GOODREADS HAVE VIRTUAL BOOK CLUBS AND DISCUSSION GROUPS.
10. CAN I READ COMPUTING FOR BIOLOGISTS PYTHON PROGRAMMING AND PRINCIPLES BOOKS FOR FREE? PUBLIC DOMAIN BOOKS: MANY CLASSIC BOOKS ARE AVAILABLE FOR FREE AS THEYRE IN THE PUBLIC DOMAIN. FREE E-BOOKS: SOME WEBSITES OFFER FREE E-BOOKS LEGALLY, LIKE PROJECT GUTENBERG OR OPEN LIBRARY.

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THERE ARE COUNTLESS FREE EBOOK SITES, BUT A FEW STAND OUT FOR THEIR QUALITY AND RANGE OF OFFERINGS.

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FUTURE OF FREE EBOOK SITES

THE FUTURE LOOKS PROMISING FOR FREE EBOOK SITES AS TECHNOLOGY CONTINUES TO ADVANCE.

TECHNOLOGICAL ADVANCES

IMPROVEMENTS IN TECHNOLOGY WILL LIKELY MAKE ACCESSING AND READING EBOOKS EVEN MORE SEAMLESS AND ENJOYABLE.

EXPANDING ACCESS

EFFORTS TO EXPAND INTERNET ACCESS GLOBALLY WILL HELP MORE PEOPLE BENEFIT FROM FREE EBOOK SITES.

ROLE IN EDUCATION

AS EDUCATIONAL RESOURCES BECOME MORE DIGITIZED, FREE EBOOK SITES WILL PLAY AN INCREASINGLY VITAL ROLE IN LEARNING.

CONCLUSION

IN SUMMARY, FREE EBOOK SITES OFFER AN INCREDIBLE OPPORTUNITY TO ACCESS A WIDE RANGE OF BOOKS WITHOUT THE FINANCIAL BURDEN. THEY ARE INVALUABLE RESOURCES FOR READERS OF ALL AGES AND INTERESTS, PROVIDING EDUCATIONAL MATERIALS, ENTERTAINMENT, AND ACCESSIBILITY FEATURES. SO WHY NOT EXPLORE THESE SITES AND DISCOVER THE WEALTH OF KNOWLEDGE THEY OFFER?

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WITH OTHERS.

