

# DIGITAL SIGNAL PROCESSING PROBLEMS AND SOLUTIONS PDF

DIGITAL SIGNAL PROCESSING PROBLEMS AND SOLUTIONS PDF DIGITAL SIGNAL PROCESSING DSP PROBLEMS AND SOLUTIONS A COMPREHENSIVE GUIDE

DIGITAL SIGNAL PROCESSING DSP IS A CRUCIAL FIELD IMPACTING NUMEROUS TECHNOLOGIES FROM AUDIO AND IMAGE PROCESSING TO TELECOMMUNICATIONS AND MEDICAL IMAGING WHILE POWERFUL DSP ALGORITHMS FACE VARIOUS CHALLENGES THIS ARTICLE EXPLORES COMMON DSP PROBLEMS AND OFFERS PRACTICAL SOLUTIONS EMPHASIZING CLEAR EXPLANATIONS AND REALWORLD APPLICATIONS

## I COMMON PROBLEMS IN DIGITAL SIGNAL PROCESSING DSP

PROBLEMS OFTEN STEM FROM LIMITATIONS IN THE HARDWARE THE ALGORITHMS THEMSELVES OR THE NATURE OF THE SIGNALS BEING PROCESSED LETS DELVE INTO SOME KEY CHALLENGES

### A QUANTIZATION NOISE ANALOGTODIGITAL CONVERSION ADC IS INHERENT IN DSP WHERE CONTINUOUS SIGNALS ARE REPRESENTED BY DISCRETE VALUES THIS DISCRETIZATION INTRODUCES QUANTIZATION NOISE A FORM OF ERROR THAT CAN SIGNIFICANTLY IMPACT SIGNAL QUALITY ESPECIALLY WITH LOW BITDEPTH ADCs THIS NOISE MANIFESTS AS UNWANTED BACKGROUND HISS IN AUDIO OR PIXELATION IN IMAGES THE HIGHER THE BITDEPTH THE FINER THE QUANTIZATION AND THE LOWER THE NOISE

### B FINITE WORD LENGTH EFFECTS DSP ALGORITHMS ARE IMPLEMENTED ON COMPUTERS WITH FINITE PRECISION ARITHMETIC THIS MEANS NUMBERS ARE REPRESENTED WITH A LIMITED NUMBER OF BITS LEADING TO ROUNDOFF ERRORS AND OVERFLOW ISSUES THESE ERRORS ACCUMULATE OVER TIME POTENTIALLY DISTORTING THE PROCESSED SIGNAL OR CAUSING INSTABILITY IN THE ALGORITHM FOR INSTANCE A SEEMINGLY MINOR ROUNDING ERROR IN A FILTER COEFFICIENT COULD LEAD TO SIGNIFICANT SIGNAL DEGRADATION AFTER MULTIPLE ITERATIONS

### C ALIASING THE SAMPLING THEOREM DICTATES THAT A SIGNAL MUST BE SAMPLED AT LEAST TWICE ITS HIGHEST FREQUENCY COMPONENT NYQUISTSHANNON SAMPLING THEOREM TO AVOID ALIASING IF THIS CONDITION ISNT MET HIGHERFREQUENCY COMPONENTS FOLD DOWN INTO THE LOWER FREQUENCIES DISTORTING

THE SAMPLED SIGNAL THIS IS COMMONLY OBSERVED AS UNWANTED ARTIFACTS IN IMAGES OR AUDIO WHERE HIGH FREQUENCIES APPEAR AS LOWFREQUENCY DISTORTIONS PROPER ANTIALIASING FILTERING BEFORE SAMPLING IS CRUCIAL D COMPUTATIONAL COMPLEXITY MANY DSP ALGORITHMS PARTICULARLY THOSE FOR HIGHRESOLUTION 2 SIGNALS OR COMPLEX OPERATIONS LIKE WAVELET TRANSFORMS REQUIRE SIGNIFICANT COMPUTATIONAL RESOURCES THIS CAN LEAD TO PROCESSING DELAYS OR THE NEED FOR POWERFUL AND EXPENSIVE HARDWARE ESPECIALLY IN REALTIME APPLICATIONS OPTIMIZATIONS LIKE FAST FOURIER TRANSFORMS FFTS AND PARALLEL PROCESSING ARE ESSENTIAL TO MITIGATE THIS CHALLENGE E NONSTATIONARY SIGNALS MANY REALWORLD SIGNALS SUCH AS SPEECH OR SEISMIC DATA ARE NON STATIONARY MEANING THEIR STATISTICAL PROPERTIES CHANGE OVER TIME THIS MAKES DESIGNING EFFECTIVE DSP ALGORITHMS CHALLENGING BECAUSE ALGORITHMS OFTEN ASSUME STATIONARITY ADAPTIVE FILTERING TECHNIQUES AND TIMEFREQUENCY ANALYSIS METHODS ARE NECESSARY TO HANDLE THESE SIGNALS EFFECTIVELY II SOLUTIONS AND MITIGATION STRATEGIES ADDRESSING THE CHALLENGES MENTIONED ABOVE OFTEN REQUIRES A COMBINATION OF CAREFUL DESIGN CHOICES ALGORITHMIC OPTIMIZATIONS AND APPROPRIATE HARDWARE SELECTION A QUANTIZATION NOISE REDUCTION TECHNIQUES LIKE DITHERING ADDING CAREFULLY DESIGNED NOISE TO MASK QUANTIZATION NOISE AND NOISE SHAPING REDIRECTING QUANTIZATION NOISE TO LESS AUDIBLE FREQUENCY BANDS CAN SIGNIFICANTLY REDUCE THE IMPACT OF QUANTIZATION NOISE USING HIGHER BIT DEPTH ADCs IS ALSO A DIRECT AND EFFECTIVE SOLUTION ALBEIT AT INCREASED COST AND COMPLEXITY B FINITE WORD LENGTH EFFECTS MITIGATION CAREFUL SELECTION OF DATA TYPES USE OF OPTIMIZED ARITHMETIC ALGORITHMS EG USING FIXEDPOINT ARITHMETIC STRATEGICALLY AND SCALING TECHNIQUES CAN HELP MINIMIZE ROUNDOFF AND OVERFLOW ERRORS USING HIGHER PRECISION ARITHMETIC EG DOUBLEPRECISION FLOATINGPOINT IS ANOTHER OPTION BUT IT COMES AT THE COST OF INCREASED COMPUTATIONAL BURDEN C ANTIALIASING EMPLOYING APPROPRIATE ANTIALIASING FILTERS BEFORE SAMPLING IS PARAMOUNT THESE FILTERS ATTENUATE HIGHFREQUENCY COMPONENTS ABOVE THE NYQUIST FREQUENCY PREVENTING ALIASING THE FILTERS DESIGN MUST CONSIDER THE SPECIFIC CHARACTERISTICS OF THE SIGNAL AND THE SAMPLING RATE D COMPUTATIONAL COMPLEXITY REDUCTION OPTIMIZING ALGORITHMS IS KEY THIS INCLUDES USING FAST ALGORITHMS LIKE FFTS INSTEAD OF DIRECT COMPUTATION OF THE DISCRETE FOURIER TRANSFORM DFT EMPLOYING PARALLEL PROCESSING

TECHNIQUES AND LEVERAGING SPECIALIZED HARDWARE LIKE DSP PROCESSORS DESIGNED FOR EFFICIENT SIGNAL PROCESSING E HANDLING NONSTATIONARY SIGNALS ADAPTIVE FILTERS WHICH ADJUST THEIR PARAMETERS IN RESPONSE TO CHANGES IN THE SIGNAL STATISTICS ARE WELLSUITED FOR NONSTATIONARY SIGNALS TIME FREQUENCY ANALYSIS TECHNIQUES LIKE WAVELET TRANSFORMS ALLOW FOR ANALYZING THE SIGNALS CHARACTERISTICS ACROSS BOTH TIME AND FREQUENCY DOMAINS OFFERING INSIGHTS THAT TRADITIONAL 3 FOURIER ANALYSIS MIGHT MISS III PRACTICAL APPLICATIONS AND CASE STUDIES THE SOLUTIONS DISCUSSED ABOVE ARE VITAL IN VARIOUS APPLICATIONS AUDIO PROCESSING NOISE REDUCTION ECHO CANCELLATION AND AUDIO COMPRESSION HEAVILY RELY ON DSP TECHNIQUES TO ADDRESS QUANTIZATION NOISE FINITE WORD LENGTH EFFECTS AND COMPUTATIONAL COMPLEXITY IMAGE PROCESSING IMAGE ENHANCEMENT FILTERING AND COMPRESSION UTILIZE DSP TO DEAL WITH ALIASING QUANTIZATION NOISE AND COMPUTATIONAL CHALLENGES MEDICAL IMAGING MRI CT SCANS RELIES HEAVILY ON ROBUST DSP ALGORITHMS FOR IMAGE RECONSTRUCTION AND NOISE REDUCTION TELECOMMUNICATIONS SIGNAL MODULATION DEMODULATION CHANNEL EQUALIZATION AND ERROR CORRECTION ALL INVOLVE COMPLEX DSP ALGORITHMS FACING VARIOUS CHALLENGES ESPECIALLY COMPUTATIONAL COMPLEXITY AND NOISE CONTROL SYSTEMS DIGITAL CONTROL SYSTEMS USE DSP TO PROCESS SENSOR DATA AND GENERATE CONTROL SIGNALS REQUIRING EFFICIENT ALGORITHMS AND PRECISE NUMERICAL COMPUTATIONS DETAILED CASE STUDIES DEMONSTRATING THESE APPLICATIONS CAN BE FOUND IN VARIOUS DSP TEXTBOOKS AND RESEARCH PAPERS READILY AVAILABLE ONLINE OFTEN IN PDF FORMAT IV KEY TAKEAWAYS UNDERSTANDING THE LIMITATIONS OF DIGITAL SIGNAL REPRESENTATION IS CRUCIAL FOR SUCCESSFUL DSP IMPLEMENTATION CHOOSING APPROPRIATE ALGORITHMS AND MITIGATING TECHNIQUES BASED ON THE SPECIFIC APPLICATION AND SIGNAL CHARACTERISTICS IS ESSENTIAL OPTIMIZATION FOR COMPUTATIONAL EFFICIENCY IS PARAMOUNT PARTICULARLY IN REALTIME APPLICATIONS A BLEND OF THEORETICAL KNOWLEDGE AND PRACTICAL EXPERIENCE IS NECESSARY FOR EFFECTIVE DSP PROBLEMSOLVING V FREQUENTLY ASKED QUESTIONS FAQs 1 WHAT IS THE DIFFERENCE BETWEEN ANALOG AND DIGITAL SIGNAL PROCESSING ANALOG SIGNAL PROCESSING MANIPULATES CONTINUOUS SIGNALS DIRECTLY WHILE DIGITAL SIGNAL PROCESSING USES DISCRETE REPRESENTATIONS OF SIGNALS FOR MANIPULATION DIGITAL PROCESSING OFFERS GREATER FLEXIBILITY AND PRECISION BUT REQUIRES ANALOGTODIGITAL AND

DIGITAL TO ANALOG CONVERSION 2 HOW DO I CHOOSE THE RIGHT SAMPLING RATE FOR MY APPLICATION THE SAMPLING RATE MUST BE AT LEAST TWICE THE HIGHEST FREQUENCY COMPONENT IN YOUR SIGNAL NYQUIST RATE TO AVOID ALIASING HOWEVER PRACTICAL CONSIDERATIONS LIKE COMPUTATIONAL COST AND DESIRED SIGNAL FIDELITY OFTEN 4 LEAD TO CHOOSING A SAMPLING RATE HIGHER THAN THE THEORETICAL MINIMUM 3 WHAT ARE THE ADVANTAGES OF USING FIXEDPOINT ARITHMETIC OVER FLOATINGPOINT ARITHMETIC IN DSP FIXEDPOINT ARITHMETIC GENERALLY OFFERS FASTER PROCESSING AND LOWER POWER CONSUMPTION HOWEVER IT HAS A LIMITED DYNAMIC RANGE AND IS SUSCEPTIBLE TO OVERFLOW AND ROUNDOFF ERRORS FLOATINGPOINT ARITHMETIC PROVIDES HIGHER DYNAMIC RANGE AND PRECISION BUT IS SLOWER AND CONSUMES MORE POWER THE CHOICE DEPENDS ON THE SPECIFIC APPLICATIONS REQUIREMENTS 4 HOW CAN I REDUCE COMPUTATIONAL COMPLEXITY IN MY DSP ALGORITHM EMPLOYING FAST ALGORITHMS LIKE FFTS PARALLEL PROCESSING AND SPECIALIZED HARDWARE DSP PROCESSORS CAN SIGNIFICANTLY REDUCE COMPUTATIONAL COMPLEXITY OPTIMIZING THE ALGORITHMS IMPLEMENTATION AND USING EFFICIENT DATA STRUCTURES CAN ALSO IMPROVE PERFORMANCE 5 WHERE CAN I FIND MORE RESOURCES ON DSP PROBLEMS AND SOLUTIONS NUMEROUS TEXTBOOKS RESEARCH PAPERS MANY AVAILABLE AS PDFS AND ONLINE COURSES DEDICATED TO DIGITAL SIGNAL PROCESSING OFFER INDEPTH INFORMATION ON VARIOUS ASPECTS INCLUDING PROBLEMSOLVING TECHNIQUES SEARCH FOR TERMS LIKE DIGITAL SIGNAL PROCESSING DSP ALGORITHMS AND DSP IMPLEMENTATION TO FIND RELEVANT RESOURCES

CHALLENGES AND SOLUTIONS IN MINERAL INDUSTRY THE MATHEMATICAL VISITOR THE MATHEMATICAL VISITOR RESOLVING NON-SMOOTH SOLUTIONS TO DISCRETIZED ILL-POSED PROBLEMS VAN NOSTRAND'S ENGINEERING MAGAZINE ACCOUNTING PROBLEMS THE DRAUGHTS POCKET MANUAL CHESS PROBLEMS, BY J. AND W.T. PIERCE. [WITH] BRENTANO'S CHESS MONTHLY BIBLIOGRAPHICAL CONTRIBUTIONS SOLUTIONS STUDY GUIDE AND PROBLEM SOLUTIONS TO ACCOMPANY BUSINESS STATISTICS: A DECISION-MAKING APPROACH ANNALS OF MATHEMATICS MATHEMATICAL MAGAZINE A MATHEMATICAL SOLUTION BOOK BIBLIOGRAPHICAL CONTRIBUTIONS FERRELL'S ADVANCED ARITHMETIC BROOKLYN CHESS CHRONICLE THE AMERICAN MATHEMATICAL MONTHLY HANDBOOK OF RESEARCH ON CURRICULUM CARSTEN DREBENSTEDT ARTEMAS MARTIN LUKE JACOB SIMCIK GEORGE WILLIAM COLLINS J. GAVIN CUNNINGHAM JAMES PIERCE (M.A.) HARVARD

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THERE ARE SOME EVENTS IN LIFE THAT ARE INEVITABLE AND THE EMERGENCE OF PROBLEMS IN THE WORKPLACE IS ONE SOLUTIONS SETS OUT TO PROVIDE REMEDIES THAT ARE ACCESSIBLE PRACTICAL MEANINGFUL AND FINAL WELL ORGANIZED AND REFERENCED TO SPECIFIC OPERATIONS THIS BOOK PROVIDES TROUBLESHOOTING AND OTHER ASSISTANCE AND SERVES AS AN ENCYCLOPEDIC REFERENCE FOR ANSWERS TO ORGANIZATIONAL PROBLEMS FOR MANAGERS AND PRACTITIONERS ALL THE FUNCTIONAL ACTIVITIES AND OPERATIONS OF ORGANIZATIONS ARE INCLUDED SO THAT ALMOST ANY PROBLEM OR ISSUE THAT MAY OCCUR WILL BE ADDRESSED IN ONE OR MORE CHAPTERS READERS WILL BE ABLE TO QUICKLY LOCATE UNDERSTAND AND USE A SPECIFIC TOOL OR TECHNIQUE TO SOLVE A PROBLEM THE DIFFERENT TOOLS AVAILABLE ARE DESCRIBED OR A SINGLE MOST USEFUL TOOL INDICATED THE TOOL IS THEN EXPLAINED IN DEPTH WITH AN EXAMPLE OF HOW IT CAN BE USED THE STRENGTHS AND WEAKNESSES OF INDIVIDUAL TOOLS ARE IDENTIFIED AND THERE ARE SUGGESTIONS FOR FURTHER HELP SOLUTIONS IS ESSENTIAL FOR ANYONE WANTING TO LEARN THE BASICS OF BUSINESS PROBLEM SOLVING AND THOSE WHO MIGHT KNOW THE

BASICS BUT WANT TO EXPAND THEIR UNDERSTANDING

INCLUDES SECTION RECENT PUBLICATIONS

PROVIDES INFORMATION ABOUT A WIDE RANGE OF CURRICULAR ISSUES AFFECTING ELEMENTARY AND HIGH SCHOOL EDUCATION EXPLORING METHODOLOGICAL AND CONCEPTUAL ISSUES LOOKING AT THE FORCES THAT SHAPE THE CURRICULUM STUDYING THE IMPACT OF THE CURRICULUM ON SPECIAL GROUPS OF STUDENTS AND DISCUSSING CONVENTIONAL SUBJECTS LIKE READING AND MATH

AS RECOGNIZED, ADVENTURE AS WELL AS EXPERIENCE ABOUT LESSON, AMUSEMENT, AS WITHOUT DIFFICULTY AS ARRANGEMENT CAN BE GOTTEN BY JUST CHECKING OUT A EBOOK **DIGITAL SIGNAL PROCESSING PROBLEMS AND SOLUTIONS Pdf** ALONG WITH IT IS NOT DIRECTLY DONE, YOU COULD SAY YES EVEN MORE ALL BUT THIS LIFE, ALL BUT THE WORLD. WE COME UP WITH THE MONEY FOR YOU THIS PROPER AS CAPABLY AS SIMPLE MANNERISM TO GET THOSE ALL. WE OFFER DIGITAL SIGNAL PROCESSING PROBLEMS AND SOLUTIONS Pdf AND NUMEROUS BOOKS COLLECTIONS FROM FICTIONS TO SCIENTIFIC RESEARCH IN ANY WAY. AMONG THEM IS THIS DIGITAL SIGNAL PROCESSING PROBLEMS AND SOLUTIONS Pdf THAT CAN BE YOUR PARTNER.

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## INTRODUCTION

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## BENEFITS OF FREE EBOOK SITES

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## TOP FREE EBOOK SITES

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## LEARNING NEW SKILLS

YOU CAN ALSO FIND BOOKS ON VARIOUS SKILLS, FROM COOKING TO PROGRAMMING, MAKING THESE SITES GREAT FOR PERSONAL DEVELOPMENT.

## SUPPORTING HOMESCHOOLING

FOR HOMESCHOOLING PARENTS, FREE EBOOK SITES PROVIDE A WEALTH OF EDUCATIONAL MATERIALS FOR DIFFERENT GRADE LEVELS AND SUBJECTS.

## GENRES AVAILABLE ON FREE EBOOK SITES

THE DIVERSITY OF GENRES AVAILABLE ON FREE EBOOK SITES ENSURES THERE'S SOMETHING FOR EVERYONE.

## FICTION

FROM TIMELESS CLASSICS TO CONTEMPORARY BESTSELLERS, THE FICTION SECTION IS BRIMMING WITH OPTIONS.

## NON-FICTION

NON-FICTION ENTHUSIASTS CAN FIND BIOGRAPHIES, SELF-HELP BOOKS, HISTORICAL TEXTS, AND MORE.

## TEXTBOOKS

STUDENTS CAN ACCESS TEXTBOOKS ON A WIDE RANGE OF SUBJECTS, HELPING REDUCE THE FINANCIAL BURDEN OF EDUCATION.

## CHILDREN'S BOOKS

PARENTS AND TEACHERS CAN FIND A PLETHORA OF CHILDREN'S BOOKS, FROM PICTURE BOOKS TO YOUNG ADULT NOVELS.

## ACCESSIBILITY FEATURES OF EBOOK SITES

EBOOK SITES OFTEN COME WITH FEATURES THAT ENHANCE ACCESSIBILITY.

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MANY SITES OFFER AUDIOBOOKS, WHICH ARE GREAT FOR THOSE WHO PREFER LISTENING TO READING.

## ADJUSTABLE FONT SIZES

YOU CAN ADJUST THE FONT SIZE TO SUIT YOUR READING COMFORT, MAKING IT EASIER FOR THOSE WITH VISUAL IMPAIRMENTS.

## TEXT-TO-SPEECH CAPABILITIES

TEXT-TO-SPEECH FEATURES CAN CONVERT WRITTEN TEXT INTO AUDIO, PROVIDING AN ALTERNATIVE WAY TO ENJOY BOOKS.

## TIPS FOR MAXIMIZING YOUR EBOOK EXPERIENCE

TO MAKE THE MOST OUT OF YOUR EBOOK READING EXPERIENCE, CONSIDER THESE TIPS.

## CHOOSING THE RIGHT DEVICE

WHETHER IT'S A TABLET, AN E-READER, OR A SMARTPHONE, CHOOSE A DEVICE THAT OFFERS A COMFORTABLE READING EXPERIENCE FOR YOU.

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## CHALLENGES AND LIMITATIONS

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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?

## FAQs

ARE FREE EBOOK SITES LEGAL? YES, MOST FREE EBOOK SITES ARE LEGAL. THEY TYPICALLY OFFER BOOKS THAT ARE IN THE PUBLIC DOMAIN OR HAVE THE RIGHTS TO DISTRIBUTE THEM. HOW DO I KNOW IF AN EBOOK SITE IS SAFE? STICK TO WELL-KNOWN AND REPUTABLE SITES LIKE PROJECT GUTENBERG, OPEN LIBRARY, AND GOOGLE BOOKS. CHECK REVIEWS AND ENSURE THE SITE HAS PROPER SECURITY MEASURES. CAN I DOWNLOAD EBOOKS TO ANY DEVICE? MOST FREE EBOOK SITES OFFER DOWNLOADS IN MULTIPLE FORMATS, MAKING THEM COMPATIBLE WITH VARIOUS DEVICES LIKE E-READERS, TABLETS, AND SMARTPHONES. DO FREE EBOOK SITES OFFER AUDIOBOOKS? MANY FREE EBOOK SITES OFFER AUDIOBOOKS, WHICH ARE PERFECT FOR THOSE WHO PREFER LISTENING TO THEIR BOOKS. HOW CAN I SUPPORT AUTHORS IF I USE FREE EBOOK SITES? YOU CAN SUPPORT AUTHORS BY PURCHASING THEIR BOOKS WHEN POSSIBLE, LEAVING REVIEWS, AND SHARING THEIR WORK WITH OTHERS.

