Strung Out: Printable Strings in Atari 2600 Games

John Aycock
Department of Computer Science
University of Calgary
2500 University Drive N.W.
Calgary, AB, Canada T2N 1N4
aycock@ucalgary.ca

1 Introduction

This report documents the raw findings from an exhaustive (and exhausting) analysis of a large corpus of Atari 2600 games to find printable strings. While similar efforts have been conducted before [3], this is the most extensive survey so far, to the best of our knowledge. We intend to analyze these results from a higher-level viewpoint later, but this report serves as a permanent record of the data and the methods we used to acquire it.

2 Printable Strings

The results reported here are based on a corpus of 1816 Atari 2600 ROM cartridge images. Duplicate images were removed – the initial corpus, as acquired, had 1840 images – but some game images have one or more prototype images too. We have not removed these, because sometimes the strings are different between these versions.

Finding printable strings was done in a manner consistent with the Unix `strings` program, where sequences of consecutive printable ASCII characters at least four characters in length were selected. In practice, because this process produces a lot of "noise", i.e., sequences that appear to be printable strings but in fact are not:

```
XXXXXXX^
66420OBDF66420FBD66420@D
3##~  #3
```

we filtered the output to make legitimate printable strings more prominent [2]. Images with legitimate-looking strings were then analyzed manually to find any additional fragments, and adjacent pieces with an apparent logical connection have been reconstructed into single lines.

The filenames in the corpus were very descriptive, and they are used to label the results below.

```
Aquaventure (CCE).bin
Aquaventure (Sea Sentinel) (08-12-1983) (Atari, Tod Frye, Gary Shannon) (Prototype) ~.bin

        looney
```

```
BMX Air Master (1989) (TNT Games, Adam Clayton) (26192) (PAL).bin

        COPYRIGHT 1989 TNT GAMES
        DEVELOPED BY SCULPTURED SOFTWARE
        WRITTEN BY ADAM CLAYTON
        GDAY
```

```
BMX Air Master (1989) (TNT Games, Adam Clayton) (26192) ˜.bin
BMX Air Master (1990) (Atari) (CX26190) (PAL).bin
BMX Air Master (1990) (Atari) (CX26190).bin

        COPYRIGHT 1989 TNT GAMES
        DEVELOPED BY SCULPTURED SOFTWARE
        WRITTEN BY ADAM CLAYTON
```

```
Big Bird's Egg Catch (Grover's Egg Catch) (Kid's Controller) (Children's Computer Workshop
    ) (1983) (Atari, Christopher H. Omarzu) (CX26104) (PAL).bin

        CHRISTOPHER H. OMARZU
```

```
Big Bird's Egg Catch (Grover's Egg Catch) (Kid's Controller) (Children's Computer Workshop
    ) (1983) (Atari, Christopher H. Omarzu) (CX26104) ˜.bin

        CHRISTOPHER H. OMARZU

        C.H.OMARZU
```

Blank lines have been inserted here and in later results to show where the fragments were separated.

```
Blueprint (1983) (CBS Electronics, Tom DiDomenico) (4L 2486 5000) (Prototype).bin
Blueprint (1983) (CBS Electronics, Tom DiDomenico) (4L 2486 5000) ˜.bin
Blueprint (1983) (CBS Electronics, Tom DiDomenico) (4L2477, 4L2482, 4L2485, 4L4171) (PAL).
    bin

        T.DIDOMENICO
```

```
Bump 'n' Jump (1983) (M Network, David Akers, Joe 'Ferreira' King, Patricia Lewis Du Long,
    Jeff Ratcliff - INTV) (MT7045) ˜.bin
Bump 'n' Jump (1989) (Telegames) (7045 A015) (PAL).bin

        Copyright 1983 Mattel Dave Akers Jeff Ratcliff Pat Dulong
```

```
Cosmic Corridor (AKA Space Tunnel) (1983) (ZiMAG - Emag - Vidco) (708-111 - GN-040).bin
Space Tunnel - O Tunel Espacial (1983) (CCE) (C-807).bin
Space Tunnel - Weltraum-Tunnel (1982) (Bit Corporation) (PG202) (PAL).bin

        LINK 1.6
        INIT /
        A
        OP
        TPLEN K
        XMIN
        YMIN
        YMAX
        XMAX
        START
        CENT
        CC09
        CC06
        CC07
        CC08
```

The strings A and OP are immediately preceded by characters with their high bits set, and if those are taken into account then those strings are AA and TOP. The last title's image is missing the K after TPLEN.

```
Die Ratte und die Karotten (AKA Gopher) (1983) (Quelle) (687.463 0) (PAL).bin
Farmer Dan (AKA Gopher) (Zellers).bin
Gopher (1983) (Carrere Video, Sylvia Day, Henry Will IV - Teldec) (USC2001) (PAL).bin
Gopher (208 in 1) (Unknown) (PAL).bin
Gopher (Gopher Attack) (1982) (U.S. Games Corporation, Sylvia Day, Henry Will IV) (VC2001)
    ˜.bin
Gopher (Unknown) (PAL).bin
Mighty Mouse (AKA Gopher) (Funvision - Fund. International Co.).bin
```

        COPYRIGHT 1982 US GAMES CORP.

```
Elk Attack (1987) (Atari, Mark R. Hahn) (Prototype) ˜.bin
```

        ELK ATTACK (c) 1987 Mark R. Hahn

```
Fatal Run (Ultimate Driving) (1989) (Atari - Sculptured Software, Steve Aguirre) (CX26162)
    (PAL) ˜.bin
Fatal Run (Ultimate Driving) (1989) (Atari - Sculptured Software, Steve Aguirre) (CX26162)
    (Prototype).bin
```

        CONGRATULATIONS ARE IN ORDER FOR A JOB WELL DONE YOU HAVE SAVED THE WORLD- YOU
            WORKED HARD AND HONORABLY -YOU DESERVE THAT VACATION YOU ASKED FOR-ROCKET CODE
             ACCEPTED-IGNITION ACTIVATED-
        FATAL RUN-PROGRAMMED BY STEVE AGUIRRE
        YOUR MISSION IS TO DRIVE TO EACH CITY DELIVERING THE MUCH NEEDED MEDICATION TO
            SAVE THE PEOPLE- THEN LAUNCH THE ROCKET TO SAVE THE WORLD-
            FANTASTIC TIME-YOUR SPEED HAS SAVED MOST OF US- NEXT TIME YOU WILL NEED TO
            PUSH HARDER-   THE RADIATION IS SPREADING-YOU MUST TRY HARDER- YOU
            MUST HAVE HAD TROUBLES-MANY HAVE DIED-   THIS IS A SMALL TOKEN OF OUR
            APPRECIATION-   WE HOPE THAT THIS HELPS-GOOD LUCK-   WE HOPE
            THIS REWARD HELPS YOU ON YOUR WAY-   YOU MUST DRIVE QUICKLY-YOU ARE OUR
            ONLY HOPE-   YOUR CARS ARMOR IS IN BAD SHAPE-FIX IT-   YOUR TIRES ARE
            SHOT-YOU SHOULD UPGRADE THEM-   YOUR CARS ENGINE NEEDS A SERIOUS TUNE-UP
                  REPAIR WHAT YOU CAN-ALL OF YOUR CAR NEEDS HELP- YOUR CAR IS STILL IN
            PRETTY GOOD SHAPE-
        -NO CODE-
        CODE- T
        CODE- TC
        CODE- TC1
        CODE- TC1L
        CODE- TC1LE
        CODE- TC1LE9
        CODE- TC1LE9H

```
Final Approach (1982) (Apollo) (AP-2009) ˜.bin
```

        ;SET JOYSITCK 1,2 TO

The typo is correct.

```
James Bond 007 (James Bond Agent 007) (1983) (Parker Brothers, Joe Gaucher, Louis Marbel)
    (PB5110) ˜.bin
```

        PJOE GAUCHER LOUIS MARBEL

It's unclear if the P is intentional or coincidental.

Lost Luggage (1981) (Apollo - Games by Apollo, Ernie Runyon, Ed Salvo) (AP-2004) [no
    opening scene] ˜.bin

```
        E,$7E,$24,$3C
        9540 BLKSUIT .BYTE 0,0,0,0,0,0,0,0,0,0
        9550   .BYTE 0,0,0,0,0,0
        9560 SUIT1 .BYTE $00,$3C,$3C,$3C,$3C,$3C,$18
        9570   .BYTE $00,$00,$00,$00,$00,$00,$00
        9580 SUIT2 .BYTE $00,$18,$18,$18,$18,$18,$00
        9590   .BYTE $00,$00,$00,$00,$00,$00,$00
        9600 SUIT3 .BYTE $00,$18,$18,$3C,$24,$66,$42
        9610   .BYT

        ,$24,$24,$24,$24,$24,$24
        9670  L

        *= $77FD
        9880 ENDSCRN JMP SCRNEND
        9890
```

Lost Luggage (1981) (Apollo - Games by Apollo, Ernie Runyon, Ed Salvo) (AP-2004) ˜.bin
Lost Luggage - La valise pi%E9g%E9e (1981) (Apollo - Games by Apollo, Ernie Runyon, Ed
    Salvo - RCA Video Jeux) (AP-2004) (PAL).bin

```
        LSR A
        LSR A
        STA SNDTYPE1
        LDA

        LDA #SUITCASE&255
        STA INTL

        A #$60
        BCS CONTINUE

        TAX

        .BYTE 0,0,0,0,0,0
        SUIT1 .BYT

        SUIT3 .BYTE $00,$18,$18,$3C,$24,$66,$42
         .BYTE $00,$00,$00,$00,$00,$00,$00
        SUIT4 .BYTE $00,$

        BRIEF .BYTE $00,$00,$00,$00,$00,$18,$18
         .BYTE $3C,$7E,$7E,$00,$00,$00,$00
        SOCKS .BYTE $00,$44,$CC,$66,
```

MagiCard (Keyboard Controller) (1981) (Computer Magic - CommaVid, John Bronstein) (CM-001)
    ˜.bin

```
        ILLADCANDASLBCCBCSBEQBITBMIBNEBPLBVCBVSCMPCPXCPYDECEORINCJMPJSRLDALDXLDYLSRORAROL
        RORSBCSTASTXSTYASLBRKCLCCLDCLICLVDEXDEYINXINYLSRNOPPHAPHPPLAPLPROLRORRTIRTSSECSED
        SEITAXTAYTSXTXATXSTYA I  X) RZ ZXZY)Y() A X Y
```

This is one long line, but it needed to be broken apart here for formatting purposes.

McDonald's - Golden Arches Adventure (Big Mac) (06-06-1983) (Parker Brothers, Dave Engman,
    Isabel Garret) (Prototype) ˜.bin
Tutankham (1983) (Parker Brothers, Dave Engman, Dawn Stockbridge) (931509) (PAL).bin
Tutankham (1983) (Parker Brothers, Dave Engman, Dawn Stockbridge) (PB5340) ˜.bin

          @PARKERBROS 83DAVEENGMAN

Midnight Magic (Pinball Wizard) (1984) (Atari, Glenn Axworthy) (CX26129) (PAL).bin
Midnight Magic (Pinball Wizard) (1984) (Atari, Glenn Axworthy) (CX26129) ˜.bin

          DESIGNED AND PROGRAMMED BY GLENN AXWORTHY.COPYRIGHT ATARI 1984.

Millipede (1984) (Atari, Jerome Domurat, Andrew Fuchs, Dave Staugas, Robert Vieira) (
    CX26118) (Prototype).bin
Millipede (1984) (Atari, Jerome Domurat, Andrew Fuchs, Dave Staugas, Robert Vieira) (
    CX26118) ˜.bin
Millipede (1984) (Atari, Jerome Domurat, Andrew Fuchs, Dave Staugas, Robert Vieira) (
    CX26118, CX26118P) (PAL).bin

          DAVE STAUGAS LOVES BEATRICE HABLIG

Parachute (1983) (Home Vision - Gem International Corp.) (VCS83123) (PAL) ˜.bin
Skydiver (AKA Parachute) (Suntek) (SS-030) (PAL).bin
Vom Himmel durch die Hoelle (AKA Parachute) (1983) (Quelle) (719.941 7) (PAL).bin

          OPEN
          APPEND
          RENAME
          CATALOG
          MON
          NOMON
          PR#
          IN#
          MAXFILES
          FP
          INT
          BSAVE
          BLOAD
          BR

          O AVAILABLE
          RANGE ERROR
          WRITE PROTECTED
          END OF DATA
          FILE NOT FOUND
          VOLUME MISMATCH
          I/O ERROR
          DISK FULL
          FILE LOCKED
          SYNTAX ERROR
          NO BUFFERS

These are strings from Apple II DOS 3.3 or 3.2 (although almost certainly 3.3 due to the game's date): the string BR is a truncated BRUN, followed by a (corrupted) LANGUAGE NOT AVAILABLE, and the final message is part of NO BUFFERS AVAILABLE. Except for the truncated strings, the last character of each had the high bit set and thus did not show up with the normal printable ASCII.

Polaris (1983) (Tigervision, Robert H. O'Neil - Teldec) (7-007 - 3.60005 VG) (PAL).bin
Polaris (1983) (Tigervision, Robert H. O'Neil) (7-007) ˜.bin

```
        >0POSV
        P1PTR
        PDIR
        GAMFLG
        VCNT
        M1PIX
        M2PIX
        SCOFF
        TTEMP
        ZTEMP
        GOCTR
        P2EXCTR
        SUBR
        SKLVL
        COLIDX
        EXPLTAB
        OBJPTR
        P2COLOR
        P1SCR
        ROWCTR
        PTCNT
        SDPTR1
        P1POSV
        P1DIR
        DBMI
        MOVCTR
        P1POSVB
        DBCTL
        P1RDIR
        STATSV
        TNDR
        TNPTR
        STATSV1
        RAMEND
        COLOR1
        COLOR2
        COLOR3
        COLOR4
        COLOR5
        COLOR6
        SCRLTIMR
        SCRLIDX
        SCRLTIM1
        #RLIDX
        BANKSTRT
        0BANKST1
        0BANK1
        BANK2
        BANK3
        DBV
        DBH
        LLIMIT
        RLIMIT
        ULIMIT  1
```

```
        DLIMIT  P
        P2INITH (
        P2INITV 5
        SETDBVH
        TUNSTRT
        BANRLP  >0NOSHP1
        5TEXT1
        5T0A
        5T1A

        6SCRLSTRT5
        T1B     I6T2B
        6T3B
        7T4B    I7T5B
        7SUN
        7CLOUD
        7START
        8CLR1
        8FRAMSEL
        8VS     78TONE    ?8TONE1   A8TONE2   K8TONE3   ^8TONE31  b8TONE32  p8TONE4

        <TNLST1
        PING
        P1EXSND J

        >POSTAB  L
```

Pompeii (Labyrinth, Lavarinth) (1983) (Apollo) (AP-2011) (Prototype) ˜.bin

```
        SCRLP1 STA STRTLINE
        NOP
        NOP
        STA WORK
        LDA (DNROCK1),Y
        STA BULLETR
        LDA MNT1,Y
        STA HIRESL

        TA COLORR
        LDY #6
        "VOLCANO LOOP 2"

        STA HIRESL
        LDA VOLC2,Y
        STA LOWRES3
        LDA LAVA2,Y

        PLCANO LOOP 3

        STA SHIFTCLR
        LDA #$E0
        STA LOWRES3
        LDY #8
        LDA #$30
        ST

        OLCAN
```

```
        IRESR
        STA WORK
        NOP
        NOP
        NOP
        NOP
        NOP
        LDA (DNROCK3),Y
        STA BULLETR
        STX HICNTLL
        JSR DELAY12
        LDA #0
        STA HICNTLL
        DEY
        BNE SCRLP3
        "BACKGROUND COLOR"
        BACKGROUND COLOR TABLE
```

Popeye (1983) (Parker Brothers, Joe Gaucher) (931519) (PAL).bin
Popeye (1983) (Parker Brothers, Joe Gaucher) (PB5370) ˜.bin

```
        Parker Bros.Joe Gaucher
```

Radar Lock (Dog Fight) (1989) (Atari, Douglas Neubauer) (CX26176) (PAL).bin
Radar Lock (Dog Fight) (1989) (Atari, Douglas Neubauer) (CX26176) ˜.bin
Super Football (1988) (Atari, Douglas Neubauer) (CX26154) ˜.bin
Super Football (1988) (Atari, Douglas Neubauer) (CX26154, CX26154P) (PAL).bin

```
        N GUOD
```

In case it's not obvious, read it backwards (cf. Solaris).

Rampage! (1989) (Activision, Robert C. Polaro) (AK-049-04) ˜.bin
Rampage! (1989) (Activision, Robert C. Polaro) (EAK-049-04B) (PAL).bin

```
        PEORIA.JOLIET.CHICAGO.KALAMAZOO.DETROIT.CLEVELAND.PITTSBURGHBALTIMORE.
            P0LAD1234ANEWARK.MANHATTAN.BOSTON.BANGOR.QUEBEC.MONTREAL.OTTAWA.TORONTO.
            MACKINAW.GREEN@BAY.MILWAUKEE.LA@CROSSE.STˆPAUL.DULUTH.BISMARCK.CUSTER.BILLINGS
            .BOISE.SPOKANE.SEATTLE.PORTLAND.
        SACRAMENTOFRESNO.BURBANK.SAN@DIEGO.LAS@VEGAS.PHOENIX.A56789RQUEAMARILLO.LUBBOCK.
            DALLAS.HOUSTON.BA!#$ROUGEN1%&(LEANSMOBILE.TAMPA@BAY.MIAMI.DAYTONA.SAVANNAH.
            CHARLOTTE.RALEIGH.RICHMOND.CHARLESTONKNOXVILLE.C)*+ANOOGAATLANTA.
            TUSCALOOSAMEMPHIS.NASHVILLE.LOUISVILLEXINGTON.CINCINNATI,-.ANAPO5SSTˆLOUIS.L/
            TLE@ROCKTULSA.WICHITA.KANSAS[]TYDES@MOINESOMAHA.LINCOLN.BOULDER.DENVER.
            CHEYENNE.SALT@LAKE.RENO.SAN@JOSE._'"ANGELESHONOLULU.MAUI.ANCHORAGE.NOME.
            FAIRBANKS.HOMEWOOD.AURORA.PLANO@ILL.
```

Rush Hour (1983) (Commavid, Ben Burch) (CM-010) (Prototype) [a1].bin

```
        A,$0284
        IFEQ  DBG

        CT'MASKS
        CMTB'''EQU'''j
        NULADR'EQU'''j
        NU'''''EQU'''j
```

Rush Hour (1983) (Commavid, Ben Burch) (CM-010) (Prototype) [a2].bin
Rush Hour (1983) (Commavid, Ben Burch) (CM-010) (Prototype) ~.bin

```
        A,$0284
        IFEQ  DBG
```

Solar Fox (1983) (CBS Electronics, Bob Curtiss) (4L1845, 4L1852, 4L1853, 4L1854) (PAL).bin

```
        (SENRCOM)
```

Solaris (Universe, Star Raiders II, The Last Starfighter) (1986) (Atari, Douglas Neubauer)
    (CX26136) (PAL).bin
Solaris (Universe, Star Raiders II, The Last Starfighter) (1986) (Atari, Douglas Neubauer)
    (CX26136) ~.bin

```
        DOUG N
```

Spike's Peak (1983) (Xonox - K-Tel Software - Beck-Tech) (6210, 7210, 06003. 99001) (PAL).
    bin

```
        +$296
        TIME1024+$296
```

Spike's Peak (1983) (Xonox - K-Tel Software - Beck-Tech) (6210, 7210, 06003. 99001) ~.bin

```
        EQ BASE+$295
```

Squoosh (Vat's Incredible!, The Grape Escape) (1983) (Apollo) (AP-2012) (Prototype) ~.bin

```
        .OR $F1
        ADDRRAML .BS 1 ;SHARED RAM BEGINNING ADDRESS
        ADDRRAMH .BS 1
        ADDR800L .BS 1 ;ATARI 800 RAM BEGINNING ADDRESS
        ADDR800H .BS 1
        BYTECNTL .BS 1 ;BYTE COUNT TO TRANSFER
        BYTECNTH .BS 1
        UNUSED .BS 1
        WORKRAML .BS 1
        WORKRAMH .BS 1
        WORK800L .BS 1
        WORK800H .BS 1
        WORKCNTL .BS 1
        WORKCNTH .BS 1
        HOLD .BS 1
        PORTA .EQ $D300 ;PORT A DATA
        PORTB .EQ $D301 ;PORT B DATA
        PACTL .EQ $D302 ;PORT A DIRECTION
        PBCTL .EQ $D303 ;PORT B DIRECTION
        .OR $600
        LDA $F4
        BNE START
        LDA #$30
        STA $F4
        LDA #$10
        STA $F6
        START LDX #5
```

```
        INITLOOP LDA ADDRRAML,X
        STA WORKRAML,X
        DEX
        BPL INITLOOP
        LDA PACTL
        AND #$FB
        STA PACTL ;SET PORT A FOR DIRECTION REGISTER
        LDA PBCTL
        AND #$FB
        STA PBCTL ;SET PORT B FOR DIRECTION REGISTER
        STX PORTA ;SET

        RAMLO

        BNE RAMLOPA
        DEC WORKCNTH
        BNE RAMLOPA
        LDX #$FF
        STX PORTB
```

Star Strike (1983) (M Network, David Akers, Patricia Lewis Du Long - INTV) (MT4313) ˜.bin
Star Strike (1989) (Telegames) (PAL).bin

        MATTEL MATTEL MATTEL MATTEL MATTEL

        D.AKERS

Star Wars - Return of the Jedi - Ewok Adventure (Revenge of the Jedi - Game I) (1983) (
    Parker Brothers, Larry Gelberg, Gary Goltz) (PB5065) (Prototype) (PAL).bin
Star Wars - Return of the Jedi - Ewok Adventure (Revenge of the Jedi - Game I) (1983) (
    Parker Brothers, Larry Gelberg, Gary Goltz) (PB5065) (Prototype) ˜.bin

        COPR 1983 PARKER BROTHERS-L. GELBERG

Star Wars - The Arcade Game (04-05-1984) (Parker Brothers, Wilfredo 'Willy' Aguilar,
    Michael Becker, Neil McKenzie, Bob Smith, Brad Stewart) (PB5540) (Prototype) (8K).bin
Star Wars - The Arcade Game (1984) (Parker Brothers, Wilfredo 'Willy' Aguilar, Michael
    Becker, Neil McKenzie, Bob Smith, Brad Stewart) (PB5540) (PAL).bin
Star Wars - The Arcade Game (1984) (Parker Brothers, Wilfredo 'Willy' Aguilar, Michael
    Becker, Neil McKenzie, Bob Smith, Brad Stewart) (PB5540) ˜.bin

        BobSmithWAguilarMBeckerNMcKenzie

        (C)84LucasfilmLtd.andATARI

Star Wars - The Arcade Game (12-15-1983) (Parker Brothers, Wilfredo 'Willy' Aguilar,
    Michael Becker, Neil McKenzie, Bob Smith, Brad Stewart) (PB5540) (Prototype).bin

        onetwoplayerHcI@QYXS@@imagic
        @@@@minesscoreZ

Superman (1979) (Atari, John Dunn - Sears) (CX2631 - 49-75152) [fixed] ˜.bin

        JOHN DUNN

Tunnel Runner (Black Box) (1983) (CBS Electronics, Richard K. Balaska Jr., Andy Frank,
    Stuart Ross) (4L 2520 5000) (Prototype).bin

```
      Richard K Balaska Jr
```

```
Word Zapper (208 in 1) (Unknown) (PAL).bin
Word Zapper (Unknown) (PAL).bin
Word Zapper (Unknown).bin
Word Zapper (Word Grabber) (1982) (U.S. Games Corporation, Henry Will IV - Vidtec) (VC1003
    ) ˜.bin

      COPYRIGHT 1982 US GAMES CORP.

      ETOAINSHRDLUPFMC

      nGAME//////////////WORD/ZAPPER/////////ECA/PMAHCEIKOORREPPAZ,E
```

3   Obfuscated Printable Strings

We extended the search to look for interesting strings that were hidden in more exotic ways. PAL images were excluded from this part of the search to keep this work tractable, leaving a still-substantial corpus of 1026 images.

b ˆ i	$\forall i \in [1, 255]$	Exclusive or
b + i	$\forall i \in [1, 255]$	Addition, also handles subtraction
rol(b, i)	$\forall i \in [1, 7]$	Rotate byte left i bits, also handles rotate right
(b ˆ 255) + 1	—	Two's complement negation

Figure 1: Deobfuscations applied to game images. b is the value of the byte being deobfuscated, and all computed values are taken modulo 256.

Applying an obfuscation engine from some of our other research work, we applied the transformations in Figure 1 to each game image and repeated the search for printable strings on the result. The filtered output was then scanned by a neuro-optical processor with multiple decades of training for recognition of English and computer code.[1]

3.1   b ˆ 64

Strings revealed as ASCII by exclusive ORing with 64 would have been encoded with A=1, B=2, C=3, and so on. Interpreting @ symbols as spaces in the strings in this section is likely a safe bet (these would have been the value 0 in the image).

```
Dragonstomper (Excalibur) (1982) (Starpath Corporation, Stephen Harland Landrum) (6) (AR
    -4400) ˜.bin
Dragonstomper (Excalibur) (1 of 3) (1982) (Starpath Corporation, Stephen Harland Landrum)
    (6) (AR-4400).bin
Dragonstomper (Excalibur) (2 of 3) (1982) (Starpath Corporation, Stephen Harland Landrum)
    (6) (AR-4400).bin
Dragonstomper (Excalibur) (3 of 3) (1982) (Starpath Corporation, Stephen Harland Landrum)
    (6) (AR-4400).bin
Excalibur (Dragonstomper Beta) (1982) (Arcadia Corporation, Stephen Harland Landrum) (6) (
    AR-4400) (Prototype) [a].bin
Excalibur (Dragonstomper Beta) (1982) (Arcadia Corporation, Stephen Harland Landrum) (6) (
    AR-4400) (Prototype).bin
Excalibur Version 36 (Dragonstomper Beta) (1982) (Arcadia Corporation, Stephen Harland
    Landrum) (6) (AR-4400) (Prototype).bin
```

---

[1]To wit, the author.

Excalibur Version 39 (Dragonstomper Beta) (1982) (Arcadia Corporation, Stephen Harland
    Landrum) (6) (AR-4400) (Prototype).bin

```
STICK@
STR
TO@MOVE
USE
STATUS
DEX
MORE
COPYRIGHT@gaNO@EFFECT
UNITS@DAMAGESTILL@STUCK
BY@SHL
DRAGON
STARPATH
OH@NO
NOBODY@HERE
FOR
@UNITS
@IN
DONATE@a__DONATE@
PRAY
DO@THAT
INVENTORY
STOPS@YOU
GET@SICKOPEN@CHEST
OPEN@DOOR
TREE
IS@LOCKED
WANTS
PAY
CASTLE
CHURCH
HUT
ESCAPE
LAKE
@STOMPERSWAMP
WERE@HITGRASS
KILLED
TRAP
ARE@DEADTEMPLE
@GOLD
PIT
GAIN
BRIDGE
@STRENGTH
DEMON
CANNOT
BUG
MISSED
WARRIOR
SCORPION
TAKE@
SPIDER
GHOUL
ID
MANIAC
```

```
SLIME
BEETLE
GUARD
SNAKE
GOLEM
MONKEY
POTION
PAPER
SHIELD
KEY
CROSS
RING
STAFF
CHARM
HANDAXE

@@FIGHT

JUST@HITA@QQQ
THE@
FEELS@WEIRD

DRAGON
@STOMPERCOPYRIGHT@gaSTARPATH
STICK
@TO
MOVE
ENLIST@MENUSE
STATUS
A@
HE@SAYS
SAYS@MOVE@ITMORE
BUY
SELL
TRADE
STR
DEX
INVENTORY
PICK@AN@ITEMWHAT@DO
OFFER@FOR
DONE
NO@THANKS
HE@WANTS
CANNOT
DO@THAT@HEREWANT
NO@EFFECT
@TO@
HE@OFFERS
ACCEPT
REFUSE
THERE@IS
SIGN@ON
THE@GATE
QABANDON@ALLHOPEi@YE@WHOENTER@HEREQ
AND@IT@WARNSQBEWARE@OF
THE@DRAGONQ
DO@YOU
```

```
FEELS@WEIRD
ENTER
LEAVE
THE@DARKNESSONE@MAN@IS
INTERESTEDi
DOOR
TRADE@SHOP
MAGIC@SHOP
HOSPITAL
TREE
CAVE
LANTERN
MEDICINE
SAPPHIRE
CHAIN
ROPE
RUBY
VITAMINS
ELIXIR
LONGBOW
SHOPKEEPER
WARRIOR
BLAST
FLASH
STUN
UNLOCK
VISION
PROTECT
ID
CHEST
HANDAXE
SHIELD
KEY
CROSS
RING
STAFF
CHARM
POTION
SPINNER
SERVICE
GOLD

DRAGON
@STOMPERCOPYRIGHT@d
STARPATH@
STICK
@TO
MOVE
USE
STATUS
A@
@MAGICCANCELS@IT
MORE
DESCENDING
HE@REFUSES
DONE
STR
```

```
DEX
INVENTORY
@ON
YOU
THE@
TOO@FAR@AWAY
WERE@HITWAS@HIT
ARE@DEADFOR"@UNITSNOBODY@HERE
MISSED
NO@EFFECT
ATTACKS
KILLED
A@WARRIOR
RECOVERS
ARE@SICKWITH@FEVER
INTO@THE@PITUSING@
FELL
HAVE
DEFEATED
ROCK
POISON@DART
TRAP
TORCH
LANTERN
MEDICINE
SAPPHIRE
CHAIN
ROPE
RUBY
VITAMINS
ELIXIR
LONGBOW
BONES
BLAST
FLASH
STUN
UNLOCK
VISION
PROTECT
CHEST
HANDAXE
SHIELD
KEY
CROSS
RING
STAFF
CHARM
POTION
ID
GOLD
DOOR
```

These are all substantially similar in terms of the type of contents found, so only the first title's results are shown; the others have fewer printable strings. One change of note is that the string STARPATH becomes ARCADIA for some of the Excalibur images. Also note the BY@SHL with the game author's initials.

Dragonstomper (Excalibur) (Preview) (1982) (Starpath Corporation, Stephen Harland Landrum) (6) (AR-4400).bin

```
DRAGON
@STOMPERCOPYRIGHT@gaSTARPATH
FIRST@LOAD
EXPLORE@THE
COUNTRYSIDE
FIGHT@EVIL
CREATURES
DISCOVER
MAGIC@ITEMS
SECOND@LOAD
THE@VILLAGE
ENLIST@AIDE
TRADE@SHOP
TRADE@WITH
SHOPKEEPERS
ENTER@THE
CAVE
THIRD@LOADiiFIND@OUT@FORYOURSELF
```

MegaBoy (Dynacom) ˜.bin

```
FITA@@TAXI@@TIME@@TENDA@TESTE@TEXTO@AQUELEELES@@FINO@@ESTE@@SAPO@@
CIDADEARVOREVIAGEM@@@@@@VIRAR@PNEU@@FEIO@@VASO@@VEIA@@ANDAR@PAREDEQUERER
LAVAR@ONDA@@FRACO@VESTIRSEMANAQUANDOESPOSAVENTO@VINHO@DESEJOCOM@@@LOBO@@@@@@@@
L[@@@@@@@@@@ANO@@@ZERO@@ERRADOJOVEM@ZEBRA@ANIMAL@@@@@@OUTONO@@@@@@BANANA
BARRILCESTA@FAROL@@@@@@BELEZAANTES@MELHORAMARGOBLUSA@@@@@@@GALHO@PEITO@PONTE@
BRILHOBOLHA@BALDE@@@@@@@@@@@@VELA@@@@@@@@@@@@@@@TROCA@QUEIJOCEREJAIGREJA@@@@@@
CIRCO@CAF]@@COBRE@CANTO@@@@@@@CASAL@PRIMO@BER\O@PERIGOD]CADADESEJO@@@@@@
DESVIOJANTARDIRETOM]DICOBURRO@DUPLO@DRAG[OEFEITOMOTOR@BASTA@@@@@@@FAMOSOPAI
@@@@@@@@@FEMEA@DEDO@@ACABARVOO@@@FLOR@@SEGUIRSELVA@SEXTA@AMIGO@FUTUROALHO@@
GENIO@UVAS@@VIOL[O@@@@@@@AL\A@@CABIDESAUDE@FOME@@INDIO@INSETODENTROMATA@@LAGOA@
LIDER@LI\[O@CARTA@LIXO@@@@@@@@MEIO@@MINUTO@@@@@@@@@@@@MACACOM[E@@@MUSEU@NA\[O@
AGULHAAVISO@NUMERO@@@@@@OSTRA@ˆRF[O@PACOTELAPIS@POVO@@@@@@@@PESSOAPOMBO@@@@@@@
PIRATA@@@@@@BOLSO@VENENO@@@@@@CARTAZBATATAPˆ@@@@REZA@@LINDA@PADRE@@@@@@@LUCRO@
ROXO@@COELHORAZ[O@SALVARVOLTAR@@@@@@ESCOLAGRITAR@@@@@@@@@@@@SOMBRASINAL@PRATA@
CANTORIRM[@@MANGA@LISO@@ARANHAMOLA@@QUADRORUA@@@FIO@@@FORTE@VER[O@@@@@@@@TEMPLO
@@@@@@TRINTAAPESAR@@@@@@PANO@@TOMATELINGUAVIAGEMPERU@@@@@@@@DOZE@@VINTE@
VELUDOVITIMAPASTA@ARMA@@PESO@@JANELA@@@@@@@@@@@@

DANT@@@ZARROW@DBANNERNBED@@@\BELL@@TBELT@@
BIKE@@NBOAT@@TBRANCH\BREAD@dBRICKS
BRUSH@DBUG@@@ZBURGERˆBUS@@@NBUTTONNCAKE@@\CAMEL@DCAMERANCANDLEˆDCAR@@@hCARROT
CASTLEDCHAIN@TCHAIR@NCHURCHˆFCIRCUSNCLIP@@ZCOMB@@\CORNETvCRAB@@NCROSS@ˆ
    CROWN@NCUP@@@DDICE@@
DRUM@@DDUCK@@
EIGHT@NELEVENDEYE@@@LFAWCETNFENCE@ˆVFIFTY@LFISH@@6FIVE@FLOWERˆLFOOT@@LFORK@@
FOUR@@NFORTY@NGATE@@ˆFGLOVE@VGUITARDGUN@@@DHAMMERDHANGERˆ
    FHEART@NHORSE@NHOUSE@DIRON@@
JAR@@@\KEY@@@DKNIFE@NLAMP@@
LEAF@@NLETTERˆDLIPS@@\LOCK@@NMOON@@,NINE@@ˆFONE@@@LPAN@@@ˆ
    DPEN@@@DPIANO@DPIPE@@DPLIER@NRABBITNRACKETNROCKETDANCHORNRULER@DSAW@@@
SEVEN@NSHIP@@DSHOE@@DSHOVEL|SIX@@@\
    SIXTY@NSKULL@DSNAKE@NSOCKS@DSTAIRSNSTAMP@NSTAR@@ˆSUN@@@NSWAN@@DSWORD@NTEAPOT
TEN@@@
THIRTY
THREE@\TORCH@NTOWER@DTRAIN@
```

TREE@@DTRUCK@TTURTLElTWELVE
TWENTY
TWO@@@DWATCH@DWHALE@DWHEEL@NWINDOWDWRENCH
ZERO@@

AGEAIRALLANTAPEARCARMBAGBEDBEEBIGBOWBOXBOYBUSCAPCARCATCOWCRYCUPDAYDOGDRYEAR
EATEGGENDEYEFANFARFATFEWFLYFOGFORFOXFRYGAYGODGUNHATHOTHOWHUGHUTICEILLINKJAM
JARJETKEYLAPLAWLAYLEGLOWMADMANMAPMAYNETNEWNUNOILOLDONEOUROUTOWLPANPAYPENPIE
PIGPOTPUTRAWRAYROWRUGRUNSADSAWSAYSEASEESHESHYSINSITSKYSPYSUMSUNTEATENTIETIN
TOOTOYTRYTWOWARWAXWHOWINYESYOUZOOALSOAUNTBABYBALDBALLBANDBANKBATHBEAMBEANBEAR
BEERBELLBELTBESTBIKEBIRDBLOWBLUEBOATBODYBONEBOOTBOSSBULLCAGECAKECALLCARDCHIN
CITYCLUBCOALCOATCOCKCODECOINCOLDCOMBCOPYCORNCRAWCUBEDARKDEADDEAFDEBTDEEPDICE
DISCDISHDOLLDOORDOWNDRUMDUCKDUSTDUTYEACHEASYECHOENVYEXITFACEFAILFAIRFALLFAME
FAREFARMFASTFEARFEELFINDFIREFISHFIVEFLAGFLATFLEAFOLDFOOLFOOTFORKFOURFREEFROG
FULLGAMEGATEGIFTGIRLGLUEGOATGOODHAIRHALFHANDHARDHATEHAWKHEADHEARHEATHELPHERE
HEROHIGHHILLHINTHOLEHOMEHOOKHORNHUNTIRONJAILJOINJOKEJULYKICKKILLKINGKISSKITE
KNEEKNOWLACELADYLAKELAMBLANDLASTLATELEAFLEAPLEFTLENSLESSLIFELIKELINELIONLIST
LOCKLONGLOOKLOSELOVELUCKLUSTMAIDMAKEMALEMANYMAREMATEMEATMESHMILKMILLMINDMINE
MINTMOONMOREMULENAILNAMENEARNESTNINENOSENOTEONLYOPENOVENOVERPACKPAGEPAINPAIR
PALEPARKPASTPEARPEELPILLPINKPIPEPLAYPOEMPOETPOOLPOORPOPEPRAYPULLPUMPPUREPUSH
RAINRAVEREADREELRENTRICERICHRIDERINGRISKROADROOFROOMROOTROPEROSESAFESAILSALE
SALTSAMESANDSEALSHIPSHOESHOTSHUTSICKSIDESILKSINKSKINSLAPSLIMSLOWSNOWSOAPSOFA
SOFTSONGSOONSOULSOURSTARSTAYSTEPSTOPSUITSWANSWIMTAILTAKETALKTALLABYSSAFTER
ALIVEANGELANGRYAPPLEAPRONARROWASHESBAKERBASINBEACHBEARDBELLYBELOWBLACKBLADE
BLINDBLINKBLOODBOARDBREADBREAKBRICKBRIDEBROWNBRUSHCAMELCANDYCANOECHAIRCHALK
CHEAPCHESSCHESTCHIEFCHILDCLEANCLEARCLOSECLOTHCLOUDCLOWNCOLORCOVERCRAZYCREAM
CROWNDANCEDELAYDEVILDIARYDIRTYDIZZYDOUBTDREAMDRESSDRILLDRINKDRUNKDWARFEAGLE
EARLYEARTHEIGHTELBOWEMPTYENEMYEQUALEXACTFAIRYFAITHFALSEFANCYFAULTFEVERFIGHT
FLAMEFLASHFLOATFLOORFLUTEFRESHFRONTFRUITGHOSTGIPSYGLASSGLOVEGOOSEGRAPEGRASS
GREEKGREENGROUPGUIDEGUILTHAPPYHEARTHEAVYHELLOHONEYHORSEHOUSEHURRYJUICEKNIFE
LARGELAUGHLEAVELEMONLIGHTLUNCHMAGICMARCHMARRYMAYBEMELONMERCYMODELMONEYMONTH
MOUSEMOUTHMUMMYMUSICNEVERNIGHTNOISENORTHNURSEOCEANONIONORDERORGANOTHERPAINT
PANTSPAPERPARTYPASTEPEACEPEARLPIANOPIECEPILOTPLACEPLANEPLANTPLATEPOINTPOWER
PRICEPRIZEPURSEQUEENQUICKQUIETRADIOREADYRIGHTRIVERROASTRULERSAINTSALADSAUCE
SEVENSHAPESHARPSHEEPSHELLSHIRTSHORTSINCESIRENSKIRTSKULLSLEEPSLICESMELLSMILE
SMOKESNACKSNAKESNORESOCKSSOUNDSOUTHSPACESPARKSPEAKSPENDSPOONSQUIDSTAGESTAIR
STAMPSTARTSTATESTEAKSTEALSTEAMSTEELSTIFFSTINKSTONESTORESTOVESUGARSWEARSWEAT
SWEETSWIFTTABLETASTETEETHTHIEFTHIGHTHINGTHINKTHREETHROWTHUMBTIGERTODAYTOOTH
TORCHTOUCHTOWELTOWERTRAINTRAMPTRASHTRIBETRICKTROOPTRUNKUNCLEUNTILVALUEVISIT
VOICEWATERWHALEWHEATWHEELWHEREWHICHWHITEWIDOWWITCHWOMANWORLDWRISTTAPE@@TAXI@@
TEAM@@TENT@@TEST@@TEXT@@THAT@@THEY@@THIN@@THIS@@TOAD@@TOWN@@TREE@@TRIP@@TRUE@@
TURN@@TYRE@@UGLY@@VASE@@VEIN@@WALK@@WALL@@WANT@@WASH@@WAVE@@WEAK@@WEAR@@WEEK@@
WHEN@@WIFE@@WIND@@WINE@@WISH@@WITH@@WOLF@@WOOD@@WOOL@@WORK@@YEAR@@ZERO@@WRONG@
YOUNG@ZEBRA@ANIMALATATUEAUTUMNAVENUEBANANABARRELBASKETBEACONBEATLEBEAUTYBEFORE
BETTERBITTERBLOUSEBOTTLEBRANCHBREASTBRIDGEBRIGHTBUBBLEBUCKETBUTTERCANARYCANDLE
CARROTCASTLECHANGECHEESECHERRYCHURCHCIRCLECIRCUSCOFFEECOPPERCORNERCOTTONCOUPLE
COUSINCRADLEDANGERDECADEDESIREDETAILDETOURDINNERDIRECTDOCTORDONKEYDOUBLEDRAGON
EFFECTENGINEENOUGHERASERFAMOUSFATHERFAWCETFEMALEFINGERFINISHFLIGHTFLOWERFOLLOW
FORESTFRIDAYFRIENDFUTUREGARLICGENIUSGRAPESGUITARHAMMERHANDLEHANGERHEALTHHUNGER
INDIANINSECTINSIDEJUNGLELAGOONLEADERLESSONLETTERLITTERMARKETMIDDLEMINUTEMIRROR
MONDAYMONKEYMOTHERMUSEUMNATIONNEEDLENOTICENUMBERORANGEOYSTERORPHANPACKETPENCIL
PEOPLEPEPPERPERSONPIGEONPILLOWPIRATEPLANETPOCKETPOISONPOLICEPOSTERPOTATOPOWDER
PRAYERPRETTYPRIESTPRINCEPROFITPURPLERABBITREASONRESCUERETURNROCKETSCHOOLSCREAM
SECONDSECRETSHADOWSIGNALSILVERSINGERSISTERSLEEVESMOOTHSPIDERSPRINGSQUARESTREET
STRINGSTRONGSUMMERSUNDAYTEMPLETHANKSTHIRTYTHOUGHTTHROATTISSUETOMATOTONGUETRAVEL
TURKEYTURTLETWELVETWENTYVELVETVICTIMWALLETWEAPONWEIGHTWINDOWWINTERYELLOW

IDADE@AR@@@@TUDO@@@@@@@@@MACACO@@@@@@BRA\O@MALA@@CAMA@@ABELHAGRANDEARCO@@CAIXA@
GAROTOONIBUSBON]@@CARRO@GATO@@VACA@@CHORARXICARADIA@@@C[O@@@SECO@@OUVIDOCOMER@
OVO@@@FIM@@@OLHO@@LEQUE@LONGE@GORDO@POUCO@MOSCA@N]VOA@PARA@@
RAPOSAFRITARALEGREDEUS@@ARMA@@CHAP]UQUENTECOMO@@ABRA\OCABANAGELO@@DOENTETINTA@
GEL]IAJARRA@JATO@@CHAVE@COLO@@LEI@@@DEITARPERNA@BAIXO@LOUCO@HOMEM@MAPA@@MAIO@@
REDE@@NOVO@@FREIRAˆLEO@@@VELHO@UM@@@@NOSSO@FORA@@CORUJAPANELAPAGAR@CANETATORTA@
PORCO@PANELA@@@@@@CRU@@@RAIO@@FILA@@TAPETECORRERTRISTESERRA@DIZER@MAR@@@VER@@@
ELA@@@TIMIDOPECADOSENTARC]U@@@ESPI[OSOMAR@SOL@@@CHA@@@DEZ@@@@@@@@@LATA@@TAMB]M
@@@@@@TENTARDOIS@@GUERRACERA@@QUEM@@VENCERSIM@@@VOCE@@@@@@@@TAMB]MTIA@@@BEBE@@
CARECABOLA@@FAIXA@BANCO@BANHO@RAIO@@FEIJ[OURSO@@@@@@@@@SINO@@@CINTO@MELHOR@@@@@
@@@@@@SOPRO@AZUL@@BARCO@CORPO@OSSO@@BOTA@@CHEFE@TOURO@GAIOLABOLO@@
CHAMARCART[OQUEIXOCIDADECLUBE@CARV[OCASACOGALO@@CˆDIGOMOEDA@FRIO@@PENTE@CˆPIA@
MILHO@CORVO@CUBO@@ESCUROMORTO@SURDO@DIVIDAFUNDO@DADO@@DISCO@PRATO@BONECAPORTA@
BAIXO@TAMBORPATO@@POEIRADEVER@CADA@@FACIL@ECO@@@INVEJASAIDA@ROSTO@FALHARFEIRA@
QUEDA@FAMA@@TARIFA@@@@@@RAPIDOMEDO@@SENTIRACHAR@FOGO@@@PEIXE@CINCO@@@@@@@@CHATO@
PULGA@DOBRA@BOBO@@P]@@@@GARFO@QUATROLIVRE@SAPO@@@CHEIO@JOGO@@@PORT[O@@@@@@
MENINACOLA@@CABRA@BOM@@@CABELOMETADEM[O@@@DURO@@ˆDIO@@@GAVI[OCABE\AOUVIR@CALOR@
AJUDA@AQUI@@HERˆI@ALTO@@MONTE@DICA@@BURACOCASA@@GANCHOCHIFRECA\ADAFERRO@
CADEIAJUNTARPIADA@JULHO@CHUTARMATAR@REI@@@BEIJO@PIPA@@JOELHOSABER@LA\O@@DAMA@@
LAGO@@OVELHATERRA@ULTIMOTARDE@FOLHA@SALTO@@@@@@@LENTE@MENOS@VIDA@@GOSTARLINHA@
LE[O@@@LISTA@TRAVA@LONGO@OLHAR@PERDERAMOR@@SORTE@DESEJOCRIADAFAZER@MACHO@MUITO@]
GUA@@COLEGACARNE@REDE@@LEITE@MOINHOMENTE@MINA@@MENTA@LUA@@@MAIS@@MULA@@UNHA@@
NOME@@PERTO@NINHO@NOVE@@NARIZ@NOTA@@Sˆ@@@@ABERTOFORNO@SOBRE@PACOTEPAGINADOR@@@
PAR@@@PALIDOPARQUE@@@@@@PERA@@CASCA@PILULAROSA@@@CANO@@JOGAR@POEMA@POETA@@@@@@@
POBRE@PAPA@@REZAR@PUXAR@BOMBA@PURO@@@@@@@@CHUVA@RAIVA@LER@@@ROLO@@ALUGARARROZ@
RICO@@MONTARANEL@@RISCO@@@@@@@@TETO@@SALA@@RAIZ@@CORDA@ROSA@@SEGUROVELA@@
VENDERSAL@@@MESMO@AREIA@LACRE@NAVIO@SAPATOTIRO@@FECHARDOENTELADO@@SEDA@@RALO@@
PELE@@TAPA@@MAGRO@LENTO@NEVE@@SAB[O@SOFA@@SUAVE@CAN\[OBREVE@ALMA@@AZEDO@ASTRO@
FICAR@PASSO@PARAR@TERNO@CISNE@NADAR@RABO@@PEGAR@FALAR@ALTO@@ABISMODEPOISVIVO@@
ANJO@@BRAVO@@MA\[@@@@@@@@FLECHACINZAS@@@@@@PIA@@@PRAIA@BARBA@@@@@@@ABAIXOPRETO@
LAMINACEGO@@PISCARSANGUETABUA@P[O@@@FREIO@TIJOLONOIVA@MARROMPINCELCAMELOBALA@@
CANOA@@@@@@@GIZ@@@BARATOXADREZPEITO@CHEFE@@@@@@@@LIMPO@CLARO@FECHARROUPA@NUVEM@
@@@@@@COR@@@TAMPA@DOIDO@CREME@COROA@DAN\ARATRASODIABO@DIARIOSUJO@@TONTO@
DUVIDASONHO@@@@@@@BROCA@BEBER@BEBADOAN[O@@AGUIA@CEDO@@TERRA@OITO@@@@@@@@@@VAZIO@
@@@@@@IGUAL@EXATO@FADA@@F]@@@@FALSO@CHIQUEFALHA@FEBRE@LUTA@@CHAMA@RAIO@@BOIAR@
CH[O@@FLAUTAFRESCOFRENTEFRUTA@@@@@@@CIGANOCOPO@@LUVA@@@GANSO@UVA@@@GRAMA@GREGO@
VERDE@GRUPO@GUIA@@CULPA@FELIZ@@@@@@@PESADOOLA@@@MEL@@@CAVALOCASA@@PRESSASUCO@@
FACA@@LARGO@RISADADEIXARLIM[O@LUZ@@@ALMO\OMAGICOMAR\O@CASAR@TALVEZMEL[O@PENA@@
MODELO@@@@@@MES@@@RATO@@BOCA@@MUMIA@MUSICANUNCA@NOITE@RUIDO@NORTE@@@@@@@
OCEANOCEBOLAORDEM@ORG[O@@OUTRO@TINTA@CAL\ASPAPEL@FESTA@PASTA@PAZ@@@P]ROLAPIANO@
PE\A@@PILOTOLUGAR@AVI[O@PLANTAPRATO@PONTO@FOR\A@PRE\O@PREMIOBOLSA@
RAINHARAPIDOQUIETORADIO@PRONTOCERTO@RIO@@@ASSAR@R]GUA@SANTO@SALADAMOLHO@SETE@@
FORMA@AFIADO@@@@@@CONCHACAMISACURTO@DESDE@SEREIASAIA@@CRANIODORMIRFATIA@CHEIRO
@@@@@@FUMA\ALANCHECOBRA@RONCARMEIA@@SOM@@@SUL@@@ESPA\OFAISCAFALAR@
GASTARCOLHERLULA@@PALCO@ESCADASELO@@INICIOESTADOBIFE@@ROUBARVAPOR@A\O@@@
RIGIDOFEDOR@PEDRA@LOJA@@FOG[O@A\UCARJURAR@SUOR@@DOCE@@VELOZ@MESA@@SABOR@
DENTESLADR[OCOXA@@COISA@PENSARTRES@@CANUDODED[O@TIGRE@HOJE@@DENTE@TOCHA@TOCAR@
TOALHATORRE@TREM@@MARCHALIXO@@TRIBO@TRUQUETROPA@TRONCOTIO@@@AT]@@@VALOR@
VISITAVOZ@@@AGUA@@BALEIATRIGO@RODA@@ONDE@@QUAL@@BRANCOVIUVA@BRUXA@MULHERMUNDO@
PULSO@

MAY@I@HAVE@Ac@OF@WATER@‘THANK@c@@@@@VERY@MUCH_@@c@IS@USED@TOSHOW@TIME_@@
BANANAS@HAVEc@COLOR_@@@@WE@MAKE@WINEWITH@c_@@@@@THE@SKY@IS@@c_@@@@@@@@@@
THE@BIRD@c_@@@@@@@@@@@DAY@IS@CLEARNIGHT@IS@c_@THE@STARS@c@AT@NIGHT_@@@
THE@DOG@c_@@@@@@@@@@@@@MY@FATHER@@cFOR@MONEY_@@MAY@I@c@YOU‘@@@@@@@@@@@c@@
GIVE@ME@@THE@SUGAR_@@I@LOVE@ICEc_@@@@@@@@@@BABIES@DRINKc_@@@@@@@@@@
I@LIKE@TO@c@THE@TV@SHOW_I@LIKE@TOcTOTHE@RADIO_@@I@LIKE@TO@c@PIANO_@@@@@@

```
WE@c@WITH@A@PENCIL_@@@@@I@c@ON@THE@@CHAIR_@@@@@@EVERYDAY@WE@c@A@BATH_@@@
EVERYDAY@WE@c@FOOD_@@@@@HEART@IS@THEc@OF@LOVE_@@THE@HAT@IS@@ON@MY@c_@@@@
I@c@SHOES_@@@@@@@@@@@@@DOGS@ARE@c@@THAN@MICE_@@THE@GRASS@@@IS@c_@@@@@@@@
DOCTORS@TAKEc@OF@US_@@@@I@c@TO@EAT@@CHOCOLATE_@@PEARS@AND@@@APPLES@AREc_
I@AM@cHAPPY_@@@@@@@@@@@@c@ME@@MAY@I@HELP@YOU@'@@c@SUPPLY@US@MILK_@@@@@@@
DRIVERS@c@@@CARS_@@@@@@@I@c@HAPPY_@@@@@@@@@@@@@@YOUcA@NICE@@BOY_@@@@@@@@
HE@c@SAD_@@@@@@@@@@@@@@@SHE@cPRETTY_@@@@@@@@@@@@IT@c@NICE_@@@@@@@@@@@@@@
BOB@AND@MARYcVERY@BUSY_@THEYcTIRED_@@@@@@@@@@@@@WE@HAVE@c@@@EYES_@@@@@@@
THE@HAND@HASc@FINGERS_@@I@USE@TO@@@@COMB@MY@c_@@THE@CLOWN@@@IS@c_@@@@@@@
CLOWNS@WORK@AT@THE@c_@@@A@DECADE@HASc@YEARS_@@@@A@WEEK@HAS@cDAYS_@@@@@@@
A@c@HAS@he@@DAYS_@@@@@@@c@BIRTHDAY@@TO@YOU@b@@@@PLEASE@@SIT@c_@@@@@@@@@@
WE@c@AT@THE@SCHOOL_@@@@@WE@c@BOOKS_@@@@@@@@@@@@IaM@A@BOY_MYSISTER@IS@Ac
THE@ROSE@IS@A@c_@@@@@@@@I@LIVE@@@@@@IN@A@c_@@@@@I@SEND@Ac@TOMY@COUSIN_@@
THE@BAKER@@@MAKES@c_@@@@FISH@LIVE@@@IN@THE@c_@@@THE@BOY@IS@cTHE@HOUSE_@@
WE@STUDYc@@@SCHOOL_@@@@@I@GO@HOME@c@BUS_@@@@@@@@LETaS@c@A@@@TAXI_@@@@@@@@
ONE@IS@A@c_@@@@@@@@@@@@@HENS@LAY@c_@@@@@@@@@@@@@THE@EIFFEL@cIS@IN@PARIS_
I@LOVE@TO@@ccGAMES_@@@@@I@USE@MY@@@@FEET@TO@c_@@I@LIKE@TO@@cFOOTBALL_@@@
THE@LAMP@IS@c@OUR@HEADS_THE@CLOTHES@ARE@IN@THEc_WE@USUALLY@@EAT@AT@THEc_
THE@DOG@RUNScTHE@STREET_WE@DRINK@@@@ORANGE@c_@@@THE@JAM@ISc_@@@@@@@@@@@@
BLACK@IS@THEcOF@MY@HAIR_LEMONS@AREc_@@@@@@@@@@@THE@PIG@ISc_@@@@@@@@@@@@@
THE@WIND@c@@@STRONGLY_@@MY@RABBIT@ISEATING@A@c_@THE@TITANIC@WAS@A@BIG@c_
ELEPHANT@IS@A@c@ANIMAL_@GIRAFFE@IS@@THE@TALLESTcI@USE@A@c@TODRY@MY@FACE_
TEACHERS@@@@WORK@AT@c_@@WE@USE@OUR@@c@TO@LISTEN_WE@USE@OUR@@EYES@TO@c_@@
WE@USE@OUR@@NOSE@TO@c_@@I@BOUGHT@A@cFOR@A@SHOW_@BIRDS@LAY@@@EGGS@IN@THEc
ITaS@COLD_@@c@THE@DOOR_@MISS@BRAZIL@IS@Ac@WOMAN_FROGS@LIVE@@IN@THE@c_@@@
BEES@PRODUCEc_@@@@@@@@@WE@LIVE@IN@@c@EARTH_@@@@SMOKE@IS@NOTGOOD@FOR@c_@@
I@DONaT@LIKEYOU_@I@cYOU_IaM@TIRED_@@I@WANT@TO@c_IaMc_@I@WANTTO@EAT_@@@@@
IaM@HUNGRY_@I@WANT@TO@c_IaM@THIRSTY_I@WANT@TO@c_CARS@HAVE@c@WHEELS_@@@@@
EVERYDAY@I@@BRUSH@MY@c_@BEFORE@MEALSI@WASH@MY@c_MY@FATHER@@cNEWSPAPER_@@
EVERYDAY@WE@TAKE@Ac_@@@@THE@SUN@@@cIN@THE@EAST_WE@USE@OUR@cTO@SPEAK_@@@
WE@c@WITH@@@SCISSORS_@@@I@SLEEP@LATEEVERY@c_@@@@c@WORK@AT@@@THE@THEATER_
SUMMER@IS@A@c@SEASON_@@@WINTER@IS@A@c@SEASON_@@@SAMMY@IS@fi@c@OLD_@@@@@@
BIRDS@FLY@@@THROUGH@THEcIaM@SICK_@I@MUST@SEE@A@cITaS@HOT_@c@THE@WINDOW_@
THE@WEATHER@IS@HOT@AT@c_THE@WEATHER@IS@COLD@ATc_MY@FATHERaS@WIFE@IS@MYc_
MY@UNCLEaS@@WIFE@IS@MYc_MY@UNCLEaS@@SON@IS@MY@c_CARPENTERS@@WORK@WITH@c_
SAILORS@@@@@WORK@IN@A@c_WE@SLEEP@ON@THE@c_@@@@@@PLUMBERS@@@@WORK@WITH@c_
A@KINGaS@@@@WIFE@IS@A@c_A@BARMAN@@@@WORKS@WITHc_POETS@@@@@@@WRITE@c_@@@@
GLASS@YOU@@@CLOCK@YELLOWGRAPESBLUE@@FLIES@DARK@@SHINE@BARKS@WORKS@HELP@@
PLEASECREAM@MILK@@WATCH@LISTENPLAY@@WRITE@SIT@@@TAKE@@EAT@@@SYMBOLHEAD@@
WEAR@@BIGGERGREEN@CARE@@LIKE@@FRUITSVERY@@EXCUSECOWS@@DRIVE@AM@@@@ARE@@@
IS@@@@IS@@@@IS@@@@ARE@@@@ARE@@@TWO@@@FIVE@@HAIR@@FUNNY@CIRCUSTEN@@@SEVEN@
MONTH@HAPPY@DOWN@@@STUDY@READ@@GIRL@@FLOWERHOUSE@LETTERBREAD@WATER@IN@@@@
AT@@@@BY@@@@TAKE@@@NUMBEREGGS@@TOWER@PLAY@@WALK@@PLAY@@OVER@@CLOSETTABLE@
ACROSSJUICE@SWEET@COLOR@SOUR@@FAT@@@BLOWS@CARROTSHIP@@BIG@@@ANIMALTOWEL@
SCHOOLEARS@@SEE@@@BREATHTICKETNEST@@CLOSE@PRETTYSWAMP@HONEY@PLANETHEALTH
HATE@@SLEEP@HUNGRYEAT@@@DRINK@FOUR@@TEETH@HANDS@READS@BATH@@RISES@MOUTH@
CUT@@@NIGHT@ACTORSHOT@@@COLD@@YEARS@SKY@@@DOCTOROPEN@@SUMMERWINTERMOTHER
AUNT@@COUSINWOOD@@SHIP@@BED@@@PIPES@QUEEN@DRINKSPOEMS@
```

These are very long strings in the game image; they have been broken up here for formatting purposes.

```
Survival Run (1983) (Data Age) (Prototype) ˜.bin

    @address@@@@@@@@@@@@
```

3.2 b ^ 128

A number of (fragments of) strings had the high bit of their characters set, likely a side effect of the development systems used.

```
Cabbage Patch Kids - Adventures in the Park (07-03-1984) (Coleco, Ed Temple) (Prototype).
    bin

        ,$FE,$FE,$BF,$7E,$18,$3E,$06,$00
        BEE2
         DFB $6C,$FE,$FE,$BF,$7E,$30,$F8,$40,$00
        *
        ******************************

        CONTAINS FLDPTR FOR BOTTOM
        *
        *
        ******************************
        *RAM USED FOR TIMEBAR AND APPLE BANDS
        *RAM RESERVED...$99--$9F...
        *
        *
        TIMEBAR = $99 ;LENGTH OF BONUS TIME ON TIME BAR
        APPLPOS = $9A ;APPLE H POSITION
        APPLMASK = $9B ;MASK TO HIDE APPLE IF NOT NEEDED
        *
        *
        ******************************
        *
        *RAM RESERVED FOR SPRITE A
        *CABBAGE PATCH GIRL
        *
        *RAM RESERVED.....$A0--$AF.....
        *
        *
        ADAT = $A0 ;INDIRECT POINTER FOR GIRLS DATA
        ACOL = $A2 ;INDIRECT POINTER FOR GIRLS COLOR
        AIMG = $A4 ;IMAGE POINTER
        AORD = $A5 ;IMAGE DISPLAY DIRECTION
        *
        AHPOS = $A6 ;GIRLS HORIZ POSITION
        AVPOS = $A7 ;GIRLS VERTICAL POSITION
        *
        GIRLSTS = $A8 ;GIRLS STATUS BYTE
        JUMPWORD = $A9 ;JUMP STATUS WORD
        JUMPTIM = $AA ;JUMPTIMER
        *
        ******************************
        *
        *RAM RESERVED FOR OTHER OBJECT (BOTH BOTTOM AND TOP
        *
        *RAM RESERVED...$B0--$BF...(TOP)
        *
        BDAT = $B0 ;INDIRECT POINTER FOR OBJECT
        BCOL = $B2 ;INDIRECT POINTER FOR COLOR
        BCOUNT = $B4 ;STARTING LINE FOR B 0BJECT
        BIMG = $B5 ;IMAGE POINTER
        BCTL = $B6 ;CONTROL BYTE
```

```
BHPOS = $B7 ;HORIZ POSITION
BVPOS = $B8 ;VERTICAL POSITION
REPOWRD = $B9 ;FLAG TO TELL IF REPOSIT OF B IN
;MIDDLE
*
*
*RAM RESERVED...$C0--$CF...(BOTTOM)
*
B2DAT = $C0 ;INDIRECT POINTER FOR OBJECT
B2COL = $C2 ;INDIRECT POINTER FOR COLOR
B2IMG = $C4 ;IMAGE POINTER
B2CTL = $C5 ;CO

CONT

NOT NEED

p $A5 ;IM

OBJECT

C0 ;INDIRECT POINTER FOR OBJECT
B2COL = $C2 ;INDIRECT POINTER FOR COLOR
B2IMG = $C4 ;IMAGE POINTER
B2CTL = $C5 ;CO
```

Cabbage Patch Kids - Adventures in the Park (07-27-1984) (Coleco, Ed Temple) (Prototype).
bin

```
EC FRAME1
 LDA #0
 STA: ATBORD
 NOP
*
 LDY APOINT
 BEQ NOA4
 DEC APOINT
 LDA (ACOL),Y
 STA ATACOL
 LDA (ADAT),Y
 STA ATADAT
*
LINE5
 LDY BPOINT
 BEQ NOB5
 LDA (BDAT),Y
 STA ATBDAT
 LDA (BCOL),Y
 STA ATBCOL
 DEY
 LDA (BDAT),Y
 TAX
 DEY
 STY BPOINT
*
MIDLIN5
 INC FRAME1
```

```
 DEC FRAME1
 NOP
 LDA DUMMY
*
 LDY APOINT
 BEQ NOA6
 DEC APOINT
 LDA (ACOL),Y
 STA ATACOL
 LDA (ADAT),Y
 STA ATADAT
LINE6
 STX BDAT
 INC FRAME1
 DEC FRAME1
 INC FRAME1
 DEC FRAME1
 INC FRAME1
 DEC FRAME1
 NOP
 NOP
 NOP
 LDX BOTFLD
 STX FLDPTR
 JMP ENDMID
*
*
*
NOA6
 INC FRAME1
 DEC FRAME1
 NOP
 NOP
 LDA DUMMY
 JMP LINE6
*
*
*
*
FINROAD
 NOP
 LDA #0
 STA ATBDAT
*
 LDX #2
 LDA SHADOWCL
 STA ATACOL
 LDA SHADOW
*
FINRDLP
 STA ATWAIT
 STA ATADAT ;DOING SHADOW
*
 LDY FLDPTR
 LDA FCOL,Y
 STA ATFCOL
 LDA FR0,Y
```

```
        STA ATFR0
        LDA FR1,Y
        STA ATFR1
        LDA FR2,Y
        STA ATFR2 ;CONTINUE DISPLAYING FIELD
*
        DEC FL

    TFR1
        LDA FR2,Y
        STA ATFR2 ;CONTINUE DISPLAYING FIELD
*
        DEC FL
```

Dice Puzzle (1983) (Panda) (106).bin

```
        SYMBOL TABLE    SORTED BY SYMBOL ADDRESS

        PAGE

        DICE8.OBJ2                  DICE8
        DICE8
```

Funky Fish (1983) (UA Limited) (Prototype) ˜.bin

```
        END NEXT SOURCE FILE
        CHN FUNKYE
```

Name This Game (1983) (Digitel).bin
Name This Game (Guardians of Treasure, Octopussy) (1982) (U.S. Games Corporation, Roger
    Booth, Sylvia Day, Ron Dubren, Todd Marshall, Wes Trager, Henry Will IV) (VC1007) ˜.
    bin
Squeeze Box (1982) (U.S. Games Corporation, Henry Will IV) (VC2002) ˜.bin

```
        COPYRIGHT 1982 US GAMES CORP.
```

Nightmare (1983) (Sancho - Tang's Electronic Co.) (TEC004).bin
Nightmare (CCE).bin

```
        BALL-NTSC2.2.OBJ4           BALL-NTSC2.2
        BALL-NTSC2.2
```

Star Wars - The Arcade Game (12-15-1983) (Parker Brothers, Wilfredo 'Willy' Aguilar,
    Michael Becker, Neil McKenzie, Bob Smith, Brad Stewart) (PB5540) (Prototype).bin

```
        lives
```

World End (2600 Screen Search Console) (Jone Yuan Telephonic Enterprise Co).bin

```
        PAGE

        ZERO-PAL1.1
```

3.3 b + 32

Text encoded this way would effectively have had control characters (including newline and tab, amongst others) removed
from the ASCII set, making space the value 0.

```
Bugs (Paddle) (1982) (Data Age) (DA1005) ˜.bin

        ORMAT
        ARTRID
        PLICATE
```

These appear to be fragments of "format", "cartridge", and "duplicate".

```
Encounter at L-5 (Megalon Invasion) (Paddle) (1982) (Data Age) (DA1001) ˜.bin

        UPLICATE FILE     H. WRITE DOS FILES
```

```
Tempest (01-05-1984) (Atari, Carla Meninsky) (CX2687) (Prototype) ˜.bin

        COPIED          CFE SERVICES     HARDIE
```

3.4 b + 49

```
CompuMate (1983) (Spectravideo) (SV-010) ˜.bin

        COMPUMATE['`CH2'`''CH3'`
```

3.5 b + 133

```
BASIC Programming (Keyboard Controller) (1979) (Atari, Warren Robinett) (CX2620) ˜.bin

        wSTATUS
        PROGRAM
        STACK
        VARIABLES
        OUTPUT
        GRAPHICS
        SYMBOLSj
        SPEEDj
```

These can be matched up with the strings shown onscreen [1].

4 Limitations

It is possible that some strings may have been overlooked, due to limitations of computer filtering or failures of human analysis. Especially unusual string encodings with no mapping to ASCII would not necessarily have been revealed by this survey either.

Acknowledgment

John Szczepaniak asked the question that indirectly led to this work.

References

[1] Atari. BASIC PROGRAMMING GAME PROGRAM(tm) INSTRUCTIONS. `http://atariage.com/manual_html_page.html?SoftwareLabelID=15`, last accessed 8 August 2014.

[2] J. Aycock. Stringlish: Improved English String Searching in Binary Images. Unpublished manuscript, July 2014.

[3] D. Boris, et al. Ascii Text in ROMs. `http://atariage.com/forums/topic/83980-ascii-text-in-roms/`, 2006, last accessed 30 July 2014.