SCS&E Report 9304
April, 1993

Marksheets: marking easier and more consistently

J. Lions

SCHOOL OF COMPUTER SCIENCE AND ENGINEERING
THE UNIVERSITY OF NEW SOUTH WALES

Abstract

This report introduces formally the idea of marksheets as an aid for examination marking. A marksheet is an A4 sheet of paper that has been specially prepared to aid the recording of mark gained by one student during an examination.

Marking is a difficult and stressful process that involves understanding and interpreting the sometimes tangled outpourings and associated thought processes of students under examination. Straight-forward approaches that suffice for small classes may no longer do so as class sizes grow.

The object of preliminary marking is to validate and extend the marking scheme, and to ensure that all ways of answering each question have been discovered, considered and calibrated. In general, the marksheet changes whenever a new style of answer, or new variation is discovered. During the cycle of review and re-assessment, the marksheet goes through several iterations.

When the time for final marking arrives, each script is assessed independently and all marks, comments and notes about the script are recorded on one single copy of the marksheet.

The preparation of a marksheet may take considerable time and effort. Marksheets cater to a need that did not exist only a few years ago, and their production is facilitated by technology that also did not exist a few years ago.

1. Introduction

This report introduces the idea of marksheets as an aid for examination marking.

Marksheets cater to a need that did not exist only a few years ago. Fortunately their production is facilitated by new technology (workstations, laser printers, Postscript page description languages, etc.) that has been developed within the same few years.

In 1990 the University of New South Wales changed its policy towards the marking of examination papers. Students may now have access to their examination papers *after* they have been marked.

I did not agree with this change, not on principle, but for practical reasons.

Marking is a difficult and stressful process that involves understanding and interpreting the sometimes tangled outpourings and associated thought processes of students under examination. Their answers must then be ranked and graded according to some scale. The difficulty increases nonlinearly with the number of scripts. Straight-forward approaches that suffice for small classes may no longer do so as class sizes grow.

I have always tried to be scrupulously fair and to mark all questions consistently. However, in the rush to complete marking within a limited time, there is usually not enough time to record all facets of the marking scheme used in particular cases. I do not consider it fair that, long after the time when the basis for awarding the mark has been decided, a marker should be placed in the position of having to explain and justify the award of a particular mark in a particular case.

My response to the changed regulations was to change the way I deal with examination scripts. Now for each examination I devise a special sheet (a *marksheet*) on which I can record all the marks for a single student. I use one sheet for each student.

Whoever drafted the University's revised policy did not envision the use of marksheets. Now, if any student asks to see his or her marked examination paper (none in 1991, and only a handful of failing students in 1992), I explain that he or she may see the script that is unchanged since they last saw it. I also explain that I regard the marksheet as private, i.e. as my personal working document. The indications are that enquiring students almost certainly want to bicker, but so far no student has persisted beyond this point.

Until the university changes its policy yet again, I rate my innovation a success, if only temporarily. If in the fullness of time, students are granted access after marking, not only to their examination scripts, but also to the 'supporting documentation', then I am better prepared now than formerly. In appropriate circumstances (to be defined) I would now agree to showing the marksheet to students.

2. Preparation

The preparation of a marksheet takes a considerable time and effort, and cannot be completed until the exam scripts have been received.

1. Timing is important. For reasons of security, marksheets should not be prepared far in advance. These days I usually prepare the preliminary version of the marksheet while the students are being examined, since I have to be available then in my office anyway.

2. Once the exam scripts have arrived, *preliminary marking* can begin. Its object is to validate and extend the marking scheme, and to ensure that all ways of answering each question have been discovered, considered and calibrated. Preliminary marking may involve trial marking of as many as 20 or 30 scripts. In general, whenever I find a new style of answer, or new variation, the marksheet changes.

3. As a result of this cycle of review and re-assessment during preliminary marking, the marksheet goes through several iterations (over a period of one or two days). Real marking does not begin during this period. Although two days represents a significant portion of the time available for marking, I am convinced that it is not too high a price.

4. Once the marksheet has been finalised, I make multiple copies, one for each script. As each script is assessed, I record all marks, comments and notes about the script on one copy of the marksheet. Since everything is recorded on the marksheet, there is no need to make any mark on the student's examination books and they can remain just as the student submitted them.

If there are more than 100 scripts to be marked, there is no question in my mind that the improved marking rate more than compensates for the extra delay and effort in getting started. If there are less than this, the advantage is less clear. If there are less than 50 scripts, older traditional approaches to marking may still be better. With increasing experience, it should be possible to lower the break-even point to say 30 scripts. Beyond this the problem is academic since we have few classes less than this in size.

3. Advantages

My original aim was to avoid the disputes that might have arisen when students gained access to their marked examination scripts. However I now see marksheets as filling a more positive role of rationalising and simplifying the whole marking process.

The use of marksheets offers several advantages:

1. The handling of examination scripts is greatly reduced.

2. Scripts can be marked serially, rather than in parallel. (In the past, I used to mark one entire question at a time, i.e. before any of the next question was attempted.)

3. Scripts can be marked in one pass, cover-to-cover, without skipping backwards and forwards, as frequently happens when scripts are marked question-by-question.
4. The scripts no longer need be kept together in one place. Although I personally have never tried it, they could be marked by several people at the same time.
5. Preliminary marking, with more careful attention to the ways students actually answer questions means that there are few unexpected surprises and little need for the marker to devise individual comments.
6. Using marksheets leads to more consistent marking.
7. Whether the marking is fairer is a different, independent matter.
8. Recording marks is simplified.
9. Final checking, to see that all questions have been marked, that nothing has been overlooked, and that marks have been totaled correctly, is much easier.
10. Other intangible benefits include: interruptions to the flow of marking are more tolerable; special pens are no longer needed for marking scripts in contrasting colours (I used to use a red felt tipped pen); and the marksheets may be preserved after the exam scripts have been destroyed.

4. Design Considerations

The form and layout of marksheets has changed and improved, as the attached samples should demonstrate.

There are at least three design problems associated with marksheets:

- the style of the examination paper;
- the content of the marksheet; and
- the layout of the marksheet.

Empirically I have found that one side of an A4 sheet suffices for an examination lasting one and one-half hours, and two sides, for up to three hours. However items have to be crowded together so that it is a tight fit. Layout design is not trivial.

5. The Examination Paper

With larger classes, examination papers must be designed for efficient assessment. Essay type questions seem to be a luxury that is increasingly difficult to afford.

For really large classes, multiple choice questions that can be marked mechanically seem to be almost unavoidable. The preparation and marking of suitable sets of multiple choice questions is a difficult task if done properly and falls outside the scope of this report.

My preference is for questions with short answers, e.g.

List the advantages and disadvantages of ....

Give a list of reasons why ....

I tend to count the number of distinct (non-repetitive), relevant points and multiply by some factor to get a mark. But if most students can find two or three points, so that full marks can be awarded for e.g. four points, why do some students write down only one?

6. Marking Resolution

In the past I have frequently found myself wanting to award half-marks. There is no reason not to mark a paper out of 200 or more, so this is what I now do.

7. Layout of the Marksheet

This is the hard part. The trick is to use all the available space, neither more nor less. With *troff* it is possible to adjust the vertical spacing so a page will always just fit, and this is always done automatically. Since most people do not want to learn *troff*, I have devised a procedure *mks* to do the messy parts.

Mks accepts a 'neutral' input data file that is not committed to any particular formatting style and is convenient to prepare. Its output is a one page marksheet. Multiple pages require multiple uses of *mks* with different data files.

The layout of marksheets has evolved over the years and has not yet stabilised. However several features seem to have settled down:

1. Each page consists of several sections arranged vertically on the page.
2. The sections are separated by lines drawn right across the page.
3. The sections include a header, several 'questions', and a trailer.
4. The header identifies the examination, and has provision for entering the student's name right at the top. (This exploits an opportunity created because the standard examination book used by the university is 265 mm in height whereas an A4 sheet is 297 mm. As a result, even when the marksheet is inserted within the examination book(s), the student's student number, name and total mark remain visible.)
5. Each question area is spread across the page and may be divided into three vertical slices of width 125 mm, 20 mm and 30 mm. I will refer to these 'slices' as *Slice A*, *Slice B*, and *Slice C* respectively.
6. Each question area consists of a title line, and three or four sections. A section is marked as a single entity and is separated from its neighbours by two short lines
7. For each section, slice A contains notes about the way marks should be awarded. There are many entries that can be ticked or circled, as the student's answer is assessed, and he or she gains or loses marks.

8. Slice B gathers and accumulates the marks awarded in Slice A.
9. Slice C records the mark for the section, gathers the marks for the whole question, and finally, provides a total for the whole sheet.
10. The standard trailer contains seven standardised comments on the student in general and scope for an individual comment if desired. The standardised comments are provided mostly for relieving marker frustration.

There is still much scope for improving the layout, especially of Slice A.

8. Samples

Several samples are provided.

A. Marksheet for *COMP 9331, August, 1914*

   This represents 'the current state of the art'. It represents a fictitious examination (*August, 1914*) synthesised from real marksheets from other years.

B. Input File for Generating Sample A

   This is the input file from which *mks* can create sample A. It is interesting to note that Sample B is almost exactly twice the length of Sample A.

C. Marksheet for *Computer Networks & Applications, 19 November, 1991*

   This is the first page (of two). It represents an intermediate stage in the evolution of my ideas. The page is divided into three vertical slices. Since 1991 slice A has grown by about 10 mm in width, and many small changes in the layouts of Slices A & B have occurred.

D. Marksheet for *Computer Networks Exam, 4 May, 1990*

   This is the first page of the earlest marksheet for which I have any record. It is included mainly for its curiosity value.

9. Conclusion

If you are not already familiar with the use of marksheets, I strongly recommend their use for any group of 100 students or more, and recommend their consideration for use with smaller groups.

Copies of some the forms I have devised and used in the past are reprinted here.

There is still much scope for improvement and innovation, and many ways to improve the format and make it more useful. Comments and suggestions will be welcomed.

(Sample A. Marksheet of August, 1914 Fictitious Examination)

Sample B. Input File for Generating Sample A

```
##############    ##############    ##############    ##############    ##############
S1 COMP 9331
S2 Networks & Applications
S3 August, 1914
CH   heading for sheet
##############
Q 1 35 General

   H a 10 Packets

N @ 2
     use alternate channels
     avoid/reduce delays
     avoid congestion
     save node storage
     limit effects of transmission errors
     identifier
     source
     destination
     ack
     message type

H b 10 Delay

A 6 PSN:f2T = (M + n - 1) mul (p/b) + n mul sf1
A 4 PSN:f2T = M mul (p/b) mul n + s mul nf1
N @ 3
     close
    explanation
     other

C Supporting Argument
E 1  Just Guessing
E 2  Not clear
E 3  plausible but wrong
E 6  reasonable: did not see overlap transmission possibility

   H c 15 Aloha
N @ 2
C Aloha
     Hawaii
     two separate channels
     low signaling rates
     central control
 other
N @ 2
C Ethernet
     Carrier-Sense
     Multiple Access
     Collision Detect
     transmit if idle
 other
N @ 2
C Wider area
     two channels
     central collision detection
     accept lower performance
     slow
 other

##################
Q 2 35 Rings and Things

   H a 10 Slotted Ring

P 2 round trip propagation time =f25 mul 10^3 / (2.10^8) = 0.25 mul 10^-4f1
P 2 bits in flight in ring =f210^7  mul  (0.25  mul  10^-4)f1 = 250
P 2 node storage: 120 mul 2 = 240 bits
P 1 total 490 bits
P 3 number of slots 490/43 = 11.3.. = 11
M 2 rounded up, not down

N @ -2
C Lose 2 marks each:
    working not explained
    rounded up
    subtracted (not added)
```

```
   H b 10 Acknowledgements ...f2Piggybacking, on Duplex link

N @ 2
C Advantages:
    reduced message numbers
    reduced overheads
    reduced bandwidth
C Disadvantages:
   acks more vulnerable to errors
    more complicated message processing
    still need normal ack
    larger header
C Other:
    acks are acked
    bundled acks
    longer ack delays

   H c 15 Selective Reject

P 5 extreme case: if all acks lost, sender and receiver windows should not overlap
P 3  sender size == receiver size; Ws + Wr ≤ N
P 5 if not enough numbers, windows must have common number
P 3 when sender retransmits receiver will mistake message as new one
P 4  assertion, devoid of justification, but nicely put
F
M 3 didn't justify why windows may be distinct
M 3 argued by example only
M 3 explanation not clear

##################
Q 3 35 Bits &  Internet

   H a 11 Bits

N @ 2
   f3Bitf1: contraction of f2binary digitf1
    8,730,00 bps
    octet = eight bits

P 5 Maximum data rate = 4096*576/48 octets/sec = 49152 octets/sec = 393216 bps
P 4 Maximum data rate = 4096*576/24 octets/sec = 98304 octets/sec = 786432 bps
P 2 Maximum data rate = 576*8/24 = 192 bps ; or thereabouts
P 1 Maximum data rate = 576/24 = 24 bps ; or thereabouts

M 3 Did not show working
M 3 calculation incomplete
M 2 lifetime = 24 mul 1

   H b 10 Reassembly by IP

N @ 3
    piece does not arrive
 other pieces age & expire
    packet may need retransmitting
    will/should happen (maybe?) (TCP?)
N @ 2
C Problems
   intermediate point selection
    reassembly done by IP
    messy
    final = best node
    disassembly may be needed again
    reassembly node may fail

   H c 14 Internet

A 8   1160 + 20 + 3 mul 20 = 1240 octets = 9920 bits
A 6 10080 (0 physical header + 4 IP header + 1 TCP header)
A 6  9760 (0 physical header + 2 IP header + 1 TCP header)
A 3  9744 (3 physical header + 1 IP header + 1 TCP header)
A 4  9600 (0 physical header + 1 IP header + 1 TCP header)
A <4 Other:
N @ -3
    confused
    skipped some details
    ignored the difficult part
    repeated TCP header
    included physical header
    did not read question

L
##################
CT  comments on candidates
##############    ##############    ##############    ##############    ##############
```

--

--

COMP 9331 *(Networks & Applications)* **August, 1914** **Questions 1, 2 & 3**

---

1 General (maximum mark: **35**) Not attempted **( )** **Q 1 :**

(a) Packets ≤ 10

use alternate channels ( ) avoid/reduce delays ( ) avoid congestion ( ) save node storage ( ) @ 2 =

limit effects of transmission errors ( ) identifier ( ) source ( ) destination ( ) ack ( )

message type ( ) **a =**

(b) Delay ≤ 10

= = PSN: $T = (M + n - 1) \times (p/b) + n \times s$ ( ) = = 6

= = PSN: $T = M \times (p/b) \times n + s \times n$ ( ) = = 4

close ( ) explanation ( ) *other* ( ) @ 3 = **b =**

Supporting Argument Just Guessing (**=1**) Not clear (**=2**) plausible but wrong (**=3**)

reasonable: did not see overlap transmission possibility (**=6**)

(c) Aloha ≤ 15

Aloha Hawaii ( ) two separate channels ( ) low signaling rates ( ) central control ( ) *other* ( ) **@ 2 =**

Ethernet Carrier-Sense ( ) Multiple Access ( ) Collision Detect ( ) transmit if idle ( ) *other* ( ) @ 2 = **c =**

Wider area two channels ( ) central collision detection ( ) accept lower performance ( ) slow ( )

other ( )

---

2 Rings and Things (maximum mark: **35**) Not attempted **( )** **Q 2 :**

(a) Slotted Ring ≤ 10

round trip propagation time = $5 \times 10^3 / (2.10^8) = 0.25 \times 10^{-4}$ (**+2**)

bits in flight in ring = $10^7 \times (0.25 \times 10^{-4})$ = 250 (**+2**) node storage: 120 × 2 = 240 bits (**+2**)

total 490 bits (**+1**) number of slots 490/43 = 11.3.. = 11 (**+3**) **a =**

rounded up, not down (**–2**) @ –2 =

Lose 2 marks each: working not explained ( ) rounded up ( ) subtracted (not added) ( )

(b) Acknowledgements ... *Piggybacking, on Duplex link* ≤ 10

Advantages: reduced message numbers ( ) reduced overheads ( ) reduced bandwidth ( ) @ 2 =

Disadvantages: acks more vulnerable to errors ( ) more complicated message processing ( ) **b =**

still need normal ack ( ) larger header ( )

Other: acks are acked ( ) bundled acks ( ) longer ack delays ( )

(c) Selective Reject ≤ 15

extreme case: if all acks lost, sender and receiver windows should not overlap (**+5**)

sender size == receiver size; Ws + Wr ≤ N (**+3**)

if not enough numbers, windows must have common number (**+5**) **c =**

when sender retransmits receiver will mistake message as new one (**+3**)

assertion, devoid of justification, but nicely put (**+4**)

didn't justify why windows may be distinct (**–3**) argued by example only (**–3**) explanation not clear (**–3**)

---

3 Bits & Internet (maximum mark: **35**) Not attempted **( )** **Q 3 :**

(a) Bits ≤ 11

Bit: contraction of *binary digit* ( ) 8,730,00 bps ( ) octet = eight bits ( ) @ 2 =

Maximum data rate = 4096*576/48 octets/sec = 49152 octets/sec = 393216 bps (**+5**)

Maximum data rate = 4096*576/24 octets/sec = 98304 octets/sec = 786432 bps (**+4**) **a =**

Maximum data rate = 576*8/24 = 192 bps ; or thereabouts (**+2**)

Maximum data rate = 576/24 = 24 bps ; or thereabouts (**+1**) Did not show working (**–3**)

calculation incomplete (**–3**) lifetime = 24 × 1 (**–2**)

(b) Reassembly by IP ≤ 10

piece does not arrive ( ) other pieces age & expire ( ) packet may need retransmitting ( ) @ 3 =

will/should happen (maybe?) (TCP?) ( ) @ 2 = **b =**

Problems intermediate point selection ( ) reassembly done by IP ( ) messy ( ) final = best node ( )

disassembly may be needed again ( ) reassembly node may fail ( )

(c) Internet ≤ 14

= = 1160 + 20 + 3 × 20 = 1240 octets = 9920 bits ( ) = = 8

= = 10080 (0 physical header + 4 IP header + 1 TCP header) ( ) = = 6

= = 9760 (0 physical header + 2 IP header + 1 TCP header) ( ) = = 6

= = 9744 (3 physical header + 1 IP header + 1 TCP header) ( ) = = 3 **c =**

= = 9600 (0 physical header + 1 IP header + 1 TCP header) ( ) = = 4

= = Other: ( ) = = <4

confused ( ) skipped some details ( ) ignored the difficult part ( ) repeated TCP header ( ) @ –3 =

included physical header ( ) did not read question ( )

( ) Candidate is marginal

( ) Candidate's problem solving ability is poor

( ) Candidate's writing is very bad/almost indecipherable

( )

Candidate's use of English (grammar and/or spelling) is poor ( )

Candidate does not show his or her working properly ( )

Candidate makes vague and/or ambiguous statements ( )

Candidate expresses his or her ideas obscurely ( )

J. Lions, April 19, 1993

Questions 1, 2 & 3

Questions 4, 5 & 6

___ Qx ; TOTAL

---

1 General (maximum mark: **40**) Not attempted **( )** **Q 1 :**

(1a) means 'open for communication' = 5

(1b) specifies the behaviour of **interfaces** between a node and a network = 5

—— layer model of interconnection + 2 **1 =**

(2) error affects boundary between messages = 6

—— two successive errors + 3 **2 =**

(3) specified to allow system to discard overdue packets = 6

—— maximum time in system before being discarded ... + 2

—— so message numbers can be reused + 3 **3 =**

—— so network does not get cluttered + 2

(4) vital information for determining when packet will return = 6

—— change when ( ) stations added/deleted; ( ) links extended + 3 **4 =**

(5) Carrier-Sense; Multiple Access; Collision Detect = 6

—— ( ) CS ; ( ) MA ; ( ) CD + 2 ea. **5 =**

(6) slotted better than pure because: = 6

—— explained terms *slotted*, *pure* + 2

—— demonstrated why synchronising doubles capacity + 4 **6 =**

noted doubled capacity ( ) + 1

---

2 Ethernet (maximum mark: **40**) Not attempted **( )** **Q 2 :**

(1) makes assumptions: optimistic to pessimistic regarding number = 10 **1 =**

(2) showed working; got answer; noted error in specification = 18

—— noted problem specification error + 3 **2 =**

—— correct answer + 10

each arithmetic error ( ) – 3

did not show working ( ) – 8

(3) appropriate answer and explanation = 12 **3 =**

—— answer but no explanation = 3

—— answer but in adequate explanation = 8

---

3 Bellman-Ford (maximum mark: **40**) Not attempted **( )** **Q 3 :**

(1) symbol definitions: = 18

—— *D*, distance across network (arbitrary units) + 3

—— *d*, distance across one link + 3

—— *i*, label for current node + 3 **1 =**

—— *k*, label for node connected to *i* + 3

—— *n*, ( ) number of hops; also ( ) time + 4

—— *z*, label for destination node + 2

(2) *multidestination routing* = 10

—— single message carries several addresses;... + 2

—— is not duplicated until paths diverge + 2 **2 =**

—— Advantages: ( ) reduced message traffic + 2

—— ( ) more vulnerable to errors ( ) uncertain error recovery (e.g. bad address) + 2 ea.

(3) Virtual circuits v. datagrams = 12

—— *virtual circuit*: path set up through network for packets to follow + 4

—— *datagram*: packet that follows independent path through network + 4 **3 =**

a datagram-equivalent is needed to set up a VC ( ) + 2

—— VCs may predominate because of increased communication speeds + 4

setting up VC reduces load at node when packet arrives ( ) + 2

( ) Candidate's use of English (grammar and/or spelling) is poor

( ) Candidate makes vague and/or ambiguous statements

( ) Candidate expresses his or her ideas obscurely

NAME **Computer Networks Exam, 4 May, 1990** **MARK**

1

_____ Not attempted = 0
_____ Unsatisfactory attempt ( ) = 0
_____ Bonus for (quality/length/understanding) +
_____ Chose BISYNC +3
_____ *BInary SYNChronous* +3
_____ Protocol (byte oriented/ASCII/STX, ETX, DLE) +4
_____ Other ( ) +

2

_____ Not attempted = 0
_____ Unsatisfactory attempt ( ) = 0
_____ Bonus for (quality/length/understanding) +

	Virtual C	Datagram
Basic Transmission		
503 × 4 × 3000 / (18 x 10E7)	0.03353	0.003353
Extra Transmission		
17 x 4 x 3000 / (18 x 10E7)		0.001134
Storage		
5 x 12 x 1800 x 10E-10	0.00108	
4 x 12 x 1800 x 10E-10	(0.000864)	
VC is cheaper	0.03461	0.034664

_____ Arithmetic error(s); accuracy ( ) -3
_____ Incorrect analysis -5

3

_____ Not attempted = 0
_____ Unsatisfactory attempt ( ) = 0
_____ Bonus for (quality/length/understanding) +
_____ Must have lost acknowledgement +4
_____ Receive window is ahead of sender +4
_____ No overlap or else +2

4

_____ Not attempted = 0
_____ Unsatisfactory attempt ( ) = 0
_____ Bonus for (quality/length/understanding) +

(a)

_____ just repeated input = 0
_____ Did not eliminate duplicate flag -2
_____ Eliminated extra zero -1
_____ Seventeen bit message [001 111 000 111 111 10] = 3
_____ One bit message [0] = 4
_____ Clerical error -2
_____ Changed 0111 1110 to 0111 111 -2

(b)

_____ Not attempted = 0
_____ Checksum calculation may generate flag pattern = 3
_____ Bitstuffing confuses checksum calculation (?) = 1

(c)

_____ Not attempted = 0
_____ Estimate (1/5) = 1
_____ 1 / (5 x 32), with explanation = 3
_____ Proper Markov analysis = 4

5

_____ Not attempted = 0
_____ Unsatisfactory attempt ( ) = 0
_____ Bonus for (quality/length/understanding) +
_____ **n** refers to iteration cycle (time) +4
_____ **K** is source node +2
_____ destination node is not explicit +2
_____ **i** ranges over nodes connected to k +2
_____ d(ik): estimated cost of travel from k to i +3
_____ D(k): estimated cost of travel from k to destination via best route +3
